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Control of Industrial VOC (Volatile Organic Compound) Emissions by Catalytic Incineration. Volume 8. Catalytic Incinerator Performance at Industrial Site C-6

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CONTROL OF INDUSTRIAL VOC EMISSIONS BY CATALYTIC INCINERATION
Volume 8. Catalytic Incinerator Performance at Industrial Site C-6

by

M. A. Palazzolo
Radian Corporation
Progress Center
3200 E. Chapel Hill Rd./Nelson Hwy.
Research Triangle Park, North Carolina 27709

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EPA Project Officer: P. Jeff Chappell
Industrial Environmental Research Laboratory
Office of Environmental Engineering and Technology
Research Triangle Park, North Carolina 27711

INDUSTRIAL ENVIRONMENTAL RESEARCH LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

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16. ABSTRACT The report is part of a two-phase EPA effort to assess the performance, suitability, and costs of various technologies to control emissions of volatile organic compounds (VOCs). In Phase 1, information was assembled from the literature on the use and cost of using catalytic incineration for VOC control. Results included: (1) a review of current and developing catalytic incineration technology, (2) an assessment of the overall performance of catalytic incinerators, (3) a review of applications where catalytic incinerators are used, (4) a comparative analysis of catalytic incineration with other competing VOC controls, (5) an examination of available methods for emission testing catalytic incinerators, and (6) an assessment of the need for additional performance test data. Phase 2 was a test program designed to increase the catalytic incinerator performance data base. It resulted in reports documenting the performance of eight catalytic incinerators at six industrial sites. The incinerators were used to control VOC emissions from solvent evaporation processes at can coating, coil coating, magnet wire, and graphic arts printing plants. Performance was measured at several process conditions at each site. Incinerator performance was characterized in terms of destruction efficiency, outlet solvent concentration, and energy usage. Design and operating data were collected. → cont'd on p. 81

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS		b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group	
Pollution	Magnet Wire	Pollution Control	13B	11F, 20C
Incinerators	Graphic Arts	Stationary Sources		14E
Catalysis	Printing Equipment	Catalytic Incineration	07D	
Organic Compounds		Volatile Organic Compounds	07C	
Volatility			20M	
Solvents		Solvent Evaporation	11K	
Evaporation		Can Coating		

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ABSTRACT

The emission of volatile organic compounds (VOCs) from industrial plants significantly increases ambient levels of photochemical oxidants, ozone, and smog. Control of industrial VOC emissions, therefore, can result in substantial environmental benefits. This study was part of a comprehensive effort by EPA/IERL-RTP to assess the performance, suitability and costs of various VOC control technologies. The objectives of the EPA program were two-fold:

(1) to provide an overview of how catalytic incineration is applied to control industrial VOC emissions and to assess the overall performance, applicability, and costs as compared to alternate VOC control technologies, and

(2) to gather actual performance data through a field testing program on existing operating industrial catalytic incinerators.

The task of meeting these objectives was accomplished in two phases. In the first phase, information was assembled from the literature on the use and cost of using catalytic incineration for VOC control. This phase of the study provides results in the following areas:

- A review of current and developing catalytic incineration technology,
- an assessment of the overall performance of catalytic incinerators,
- a review of applications where catalytic incinerators are used,
- a comparative analysis of catalytic incineration with other competing VOC controls,
- an examination of the available methods for emission testing catalytic incinerators, and
- an assessment of the need for additional performance test data.

The second phase was a testing program designed to increase the catalytic incinerator performance data base. The testing program was planned so that 8 catalytic incinerators at industrial sites would be tested.

The outputs from this phase of the program consisted of a series of reports documenting the performance of 8 catalytic incinerators at 6 industrial sites. All 8 incinerators were used to control VOC emissions from solvent evaporation processes. Incinerators at can coating, coil coating, magnet wire, and graphic arts printing plants were tested. The performance measurements were made at several process conditions at each of the sites visited. Incinerator performance was characterized in terms of destruction efficiency, outlet solvent concentration, and energy usage. Incinerator design and operating data, such as operating temperature, solvent type, catalyst volume and age, were collected to document the operating conditions during the tests.

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SECTION 1

INTRODUCTION

Radian Corporation is conducting a testing program for the EPA (Contract No. 68-02-3171, Work Assignment 50) to document the performance of catalytic incinerators applied to industrial processes for volatile organic compound (VOC) control. Performance data collected at each test site is being summarized in a series of test reports (Volumes 3-8). A final report (Volume 2) presents comparative results of data from all test sites. This report presents test results from the incinerator at Plant C-6, an aluminum foil coating plant.

VOC emissions are of concern to the EPA because they may react photochemically in the atmosphere to form photochemical oxidants. National Ambient Air Quality Standards (NAAQS) for photochemical oxidants are routinely exceeded in many areas of the United States. The objective of the current program is to gather performance data on industrial catalytic incinerators. This data will allow the EPA and industry to assess the potential reduction in VOC emissions that can be expected from using catalytic incinerators on various industrial processes. For purposes of discussion, the term VOC is used throughout this report to mean any volatile organic compound in the gas stream sampled.

The approach taken to evaluate the performance of industrial catalytic incinerators consisted of (1) developing plant-specific test plans and test methods to characterize incinerator performance and (2) performing several days of comprehensive on-site testing for each incinerator. Testing focused on the simultaneous monitoring of inlet and outlet VOC concentrations and measurement of incinerator operating conditions.

Incinerator destruction efficiencies presented in this report were determined by measuring inlet and outlet VOC concentrations according to EPA Method 25A. The Method 25A results represent total hydrocarbon (THC) concentrations in the gas streams on a carbon (C_1) basis. These THC values were determined by comparing the flame ionization detector (FID) response of the multicomponent gas streams sampled to the FID response of propane standards. The THC values represent a single FID response to a mixture of solvents and not the sum of responses to individual solvents in the mixture. The THC concentrations presented in this report cannot be compared to the percentages of individual components in the gas streams.

This report is divided into four sections beyond the Introduction (Section 1.0). Section 2.0 provides a summary of the results of the test. Section 3.0 gives a detailed process description and Section 4.0 discusses the sampling and analytical methods used at the site. The results of testing and analysis are presented in Section 5.0.

SECTION 2

SUMMARY

The catalytic incinerator at Plant C-6, an aluminum foil coating plant, was performance tested between February 25 and March 4, 1983. Testing focused on characterizing the effects of operating parameters on incinerator destruction efficiency and determining energy usage and heat recovery rates. Results of the testing are summarized in this section.

The catalytic incinerator at Plant C-6 destroys solvents exhausted from a drying oven on a coil coating line. The coating line produces coated aluminum foil for use in food packaging. The primary solvents used at Plant C-6 are methyl ethyl ketone (MEK) and toluene. Solvents used to a lesser degree include isopropanol, n-butyl alcohol, xylenes and cellosolve acetate.

The incinerator at Plant C-6 handles an inlet solvent laden air (SLA) flowrate of approximately 7.69 m^3/s at 149°C (16,300 acfm at 300°F). The incinerator has catalyst beds containing catalyst coated ceramic honeycombs and is typically operated at a catalyst inlet temperature of 288°C (550°F).

During the ten-day test period at Plant C-6, incinerator performance was characterized for six different products, a wide range of inlet solvent mass flowrates, two operating temperatures and two solvent laden air residence times. Inlet and outlet solvent concentrations were monitored with total hydrocarbon (THC) analyzers and gas chromotographs (GC). The results of the THC sampling are summarized in Table 2-1.

TABLE 2-1. SUMMARIZED THC SAMPLING RESULTS

Product ID	Range of Inlet THC Concentrations (ppmv)[a]	Range of Outlet THC Concentrations (ppmv)[a]	Range of Destruction Efficiencies	Range of Catalyst Bed Inlet Temperatures °C (°F)
A	11,514 - 12,864	286 - 295	97.3 - 97.5	274 - 285 (525 - 545)
B	8,794 - 12,358	218 - 305	96.5 - 97.8	277 - 341 (530 - 645)
C	8,806	286	96.5	274 (525)
D	6,222 - 6,485	248 - 272	95.3 - 95.9	252 - 288 (485 - 550)
E	9,212 - 11,244	250 - 279	97.3 - 97.5	277 - 307 (530 - 585)
F[b]	8,006 - 8,811	199 - 201	97.3 - 97.6	285 (545)

[a] ppmv - parts per million by volume as carbon. Inlet data are for the main incinerator inlet gas stream from the oven. Two other inlet streams were from fugitive emissions near the coating applicator. Outlet data are for the incinerator outlet.

[b] Product F tested at longer solvent laden air residence time.

The results in Table 2-1 show that the destruction efficiency for the incinerator varied over a relatively narrow range. Major factors affecting the efficiencies were operating temperature and inlet solvent mass flowrates. Limited data also suggest that SLA resident time is an important parameter.

Variation of the catalyst inlet temperature from 285°C (545°F) to 341°C (645°F) for one product showed an efficiency increase from 97.0 to 97.6 percent. For this same product, an increase in the inlet THC mass flowrate from 85 kg/hr to 98 kg/hr resulted in an efficiency increase from 96.6 to 97.1 percent. A statistical analysis has verified that these small increases in efficiency are due to real functional relationships and not random sampling and measurement error.

Outlet gas from the incinerator at Plant C-6 is recycled to the coating oven and supplies heat needed to dry the coating. Outlet gas recirculation averaged 54 percent and heat recovery ranged from 25 to 36 percent, depending on the operating temperature. The average natural gas energy usage during the testing was 2.8×10^9 J/hr (2.65×10^6 Btu/hr).

SECTION 3

PROCESS DESCRIPTION

Plant C-6 produces coated aluminum foil for use in the food packaging industry and falls under SIC 3497, the metal foil and leaf industry. In this coil coating process, aluminum foil is unwound from a coil and passed through a coating applicator where pigments dispersed in solvents are applied to the foil. The solvents are then driven off the foil in a drying oven and the coated foil is recoiled. The exhaust from the coating oven is ducted to a catalytic incinerator for solvent destruction. The plant operates 24 hours per day, 5 to 7 days per week.

The incinerator tested at Plant C-6 is described in this section. A general description of the incinerator and its relationship to the coil coating process is given in Section 3.1. Instrumentation used to monitor and control the incinerator is discussed in Section 3.2.

3.1 CATALYTIC INCINERATION PROCESS

The incinerator tested at Plant C-6 is used to destroy solvent emissions from a two-side coil coating line. The coating line is actually two coaters in series, with one coating station and drying oven for each side of the foil. For two-side coating, the foil must be passed through each coating station and its corresponding drying oven. Solvent emissions from only one of the coating stations and drying ovens are destroyed in the incinerator. Emissions from the other oven are currently not abated because this oven is used infrequently.

In addition to the exhaust from the top portion of the oven, fugitive VOC emissions from the coating area are also ducted to the incinerator. The fugitive emissions are captured with "floor sweeps" located on each side of the coating applicator.

The coatings used at Plant C-6 contain mostly toluene and methyl ethyl ketone (MEK). However, some of the coatings also contain xylenes, isopropyl alcohol, n-butyl alcohol and/or cellosolve acetate. Weight percent solids of the coatings range from 21.0 to 31.2 percent by weight. Based on plant data, solvent usage rates averaged approximately 77 kg/hr (170 lb/hr) during the testing.

A process flow diagram showing the incinerator and coil coater is given in Figure 3-1. For simplicity, Figure 3-1 shows only one drying oven and coating applicator. Emissions from the other oven and coating applicator are not ducted to the incinerator tested.

As shown in Figure 3-1, a large blower draws solvent laden air (SLA) from the first two oven zones and from the floor sweeps. The SLA passes into the burner zone of the incinerator where it is heated to 288°C (550°F) by the combustion of natural gas. A portion of the floor sweep gas serves as the combustion air for the burner.

The hot gas from the burner zone passes first through a high temperature filter for particulate removal and then through the catalyst bed for solvent destruction. Approximately 50 percent of the incinerator outlet gas, typically at 399 to 427°C (750 to 800°F), and a portion of the floor sweep gas are recirculated to the first two zones of the oven. Dampers control the amount of air recirculated to maintain a preset oven zone temperature. This zone temperature varies with the coating being dried. The rest of the incinerator outlet gas exhausts to the atmosphere via a stack.

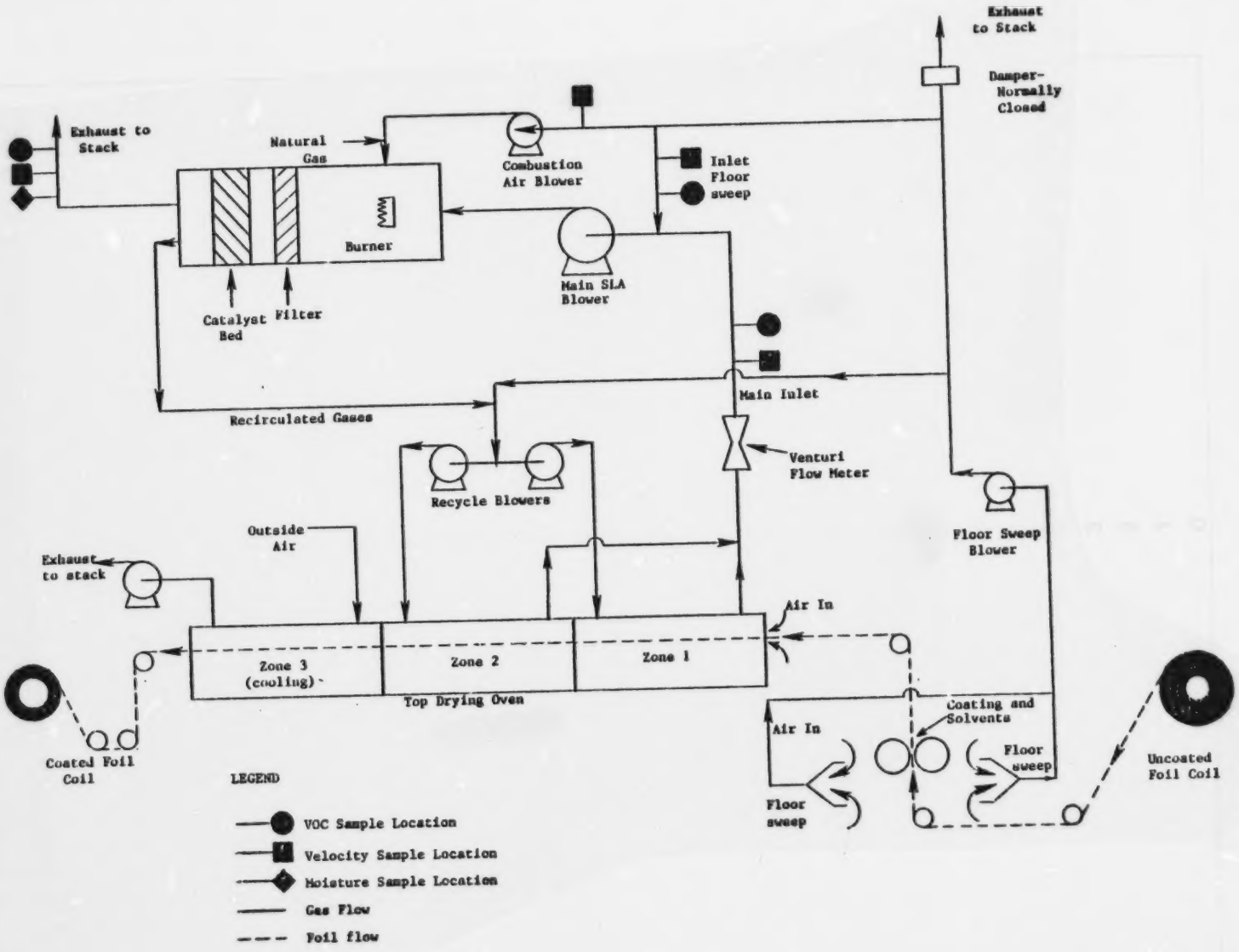

Figure 3-1. Process flow diagram for Plant C-6.

The cooling zone of the oven uses outside ambient air to cool the coated foil before it is recoiled. The exhaust from the cooling zone of the oven is vented back outside and does not pass through the incinerator.

The gas flowrate of SLA from the drying ovens is constant for different coatings or products. The incinerator inlet temperature and the pressure drop across a venturi flow meter are used to maintain a constant flowrate of 4.48 Nm^3/s (9500 scfm) at the venturi. While the gas flowrate is constant for different products, the inlet solvent concentration and the solvent type vary from one product to the next. The inlet solvent concentration also varies with line speed and coil width.

During system start-up, the burner in the incinerator is used to heat the drying oven. Outlet gas from the incinerator is recycled back to the oven and the floor sweep gas is vented to the atmosphere. Once the desired oven temperature is achieved, the coating line is started and the damper in the floor sweep stack is closed. The line speed is then increased to between 1.0 and 2.5 m/s (200 and 500 ft/min).

The incinerator tested at Plant C-6 was designed and manufactured by DuPont and had a destruction efficiency guarantee of 95 percent. The catalyst in the incinerator is a catalyst coated ceramic honeycomb with the tradename Torvex^R. The incinerator contains 21, 10 x 12 x 12 inch catalyst modules, giving a total catalyst volume of 0.50 m^3 (17.5 ft^3). For this catalyst volume and a 60 percent void fraction, the residence time of the SLA in the catalyst bed is approximately 0.03 seconds. The total surface area of the catalyst is approximately 435 m^2 (4690 ft^2).[1]

The incinerator tested at Plant C-6 handles an inlet SLA flowrate of approximately 7.69 m^3/s at 149°C (16,300 acfm at 300°F). The incinerator began operation on January 24, 1983 and had the original catalyst at the time of testing.

3.2 INSTRUMENTATION AND CONTROLS

The incinerator at Plant C-6 is instrumented so that operation of the incinerator is fully automatic after system start-up. The following instrumentation and controls are installed on the incinerator:

- digital readouts indicating incinerator inlet temperature, catalyst bed inlet and outlet temperatures and oven zone temperatures;
- Magnehelic^{R} gauges indicating pressure drops across the venturi flow meter, catalyst bed, burner, and filter;
- Magnehelic^{R} gauges indicating static pressures at various locations, such as in the floor sweep lines and the gas recycle ducts;
- a catalyst outlet temperature controller to maintain an outlet temperature setpoint of 400°C (750°F);
- a catalyst inlet temperature controller to maintain an inlet temperature setpoint of 288°C (550°F);
- damper controllers in the recycle ducts to maintain preset oven temperatures; and
- a damper controller in the main incinerator inlet duct to maintain a gas flowrate of approximately 4.48 Nm^3/s (9500 scfm).

In addition, the incinerator is instrumented with a number of alarms to indicate fan failure, flame loss, and temperature excursion. An LEL meter also is available to initiate system shutdown in the event that solvent levels in the oven become too high.

SECTION 3 REFERENCES

1. Du Pont Torvex^{R} Ceramic Honeycomb Data Sheet. E.I. Du Pont de Nemours & Co., Wilminton, Delaware. May 1981.

SECTION 4

SAMPLING AND ANALYTICAL PROCEDURES

Testing procedures followed during the performance evaluation of the catalytic incinerator operated by Plant C-6 are presented in this section. Sampling procedures are discussed in Section 4.1 and analytical procedures are discussed in Section 4.2. Quality assurance/quality control procedures and results for Plant C-6 are discussed in the Quality Assurance Project Plan and Quality Assurance Report (Volume 9) for this program.

4.1 SAMPLING PROCEDURES

This section describes the sampling methodology Radian used to characterize the operation and determine the destruction efficiency of the Plant C-6 incinerator. EPA reference methods were typically used; however, some non-reference methods or modifications of reference methods were needed. The modifications are discussed in this section. A sampling procedure matrix is presented in Table 4-1.

4.1.1 Sample Acquisition for Volatile Organic Compounds and Carbon Dioxide

Both the incinerator inlet and outlet gas streams were continuously sampled throughout the test. A three-hole sampling rake was used to extract the gas sample from the main gas stream. As required by Method 25A specifications, the sampling rake had holes 3.2 mm (1/8 in) in diameter drilled in the tubing at a relative location of 16.7, 50 and 83.3 percent of the equivalent duct diameter. Sample gas passed through 1.8 m (6 ft) of heat-traced stainless steel line and a heated (205°C, 400°F) sampling pump before entering a heat-traced Teflon^{R} umbilical that carried it to a mobile laboratory. During transport through the umbilical from the duct to the laboratory, the sample gas was maintained at 100°C (212°F).

TABLE 4-1. SAMPLING PROCEDURES MATRIX

Parameter	Procedure
Fixed Gases and Volatile Organic Carbon (VOC) Content	EPA Method 25A
Gas Sample for GC/MS Analysis	Evacuated canister equipped with vacuum flow regulator
Moisture	EPA Method 4
Velocity/Volumetric Flow Rate	EPA Methods 1 and 2
Temperature	Thermocouple
Duct Pressure	Magnehelic® gauge or manometer
Other Process Data	Plant monitors or O&M records

A manifold system inside the mobile laboratory was used to split the sample streams for analysis with two types of instruments, an organic species analyzer and a THC analyzer. A schematic of this sampling arrangement is shown in Figure 4-1.

4.1.2 Acquisition of Organic Species for GC/MS Analysis

Samples for GC/MS analysis were acquired at the outlet of the sample acquisition system using evacuated canisters. The canisters were cleaned, evacuated, and the absolute pressure recorded before sampling. Immediately prior to sampling, canister pressure was remeasured to ensure that no leakage had occurred. Flow regulators were used to provide a constant flow over the 20-minute sampling period. Gas exiting the sampling manifold was passed through a set of impingers to knock out moisture and heavy organics. The flow regulators and canisters were attached between the last impinger (with silica gel) and next to last impinger (empty).

After sample collection was completed, the canister input valves were closed and the canisters were disconnected from the sample line. Then absolute canister pressure was again measured. Prior to shipment, all canister valves were tightened and stem nuts sealed with Swagelok^{R} plugs. When received at Radian's laboratory, canister pressure was remeasured to ensure no leakage had occurred. The canisters were then pressurized with UHP N_2 to 10-15 psig to provide pressure for removing the sample.

4.1.3 Moisture Determination

The moisture content of the incinerator exhaust stream was determined using the methodology prescribed in EPA Method 4. Based on this method, a measured volume of particulate-free gas is pulled through a chilled impinger train. The quantity of water condensed in the impingers is determined gravimetrically and then related to the volume of gas sampled to determine the moisture content. Figure 4-2 graphically illustrates the sampling train which is used for moisture determination.

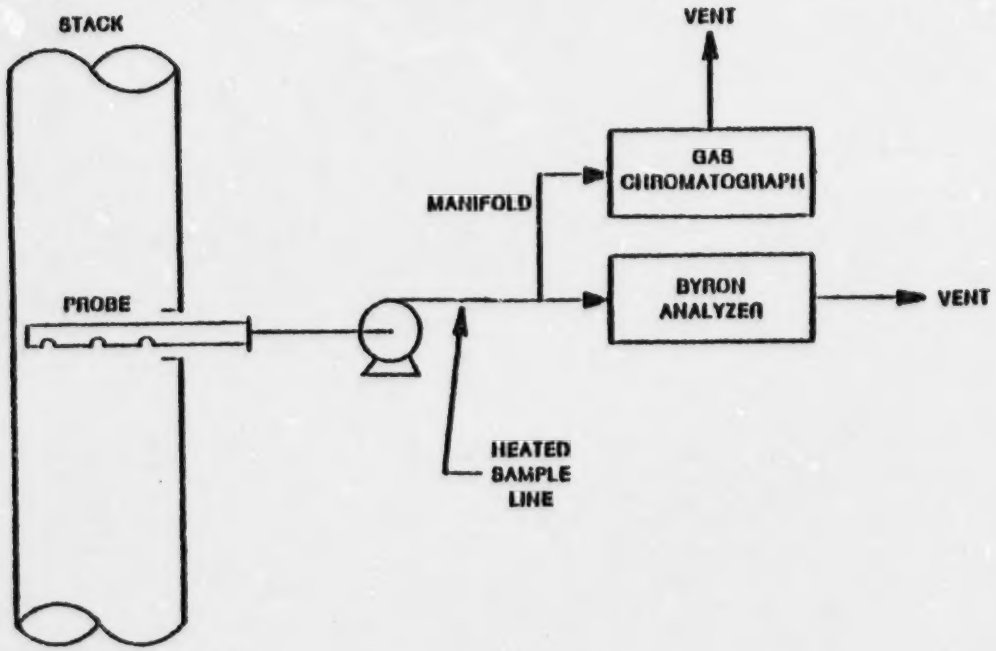

Figure 4-1. Positive pressure gas sampling system.

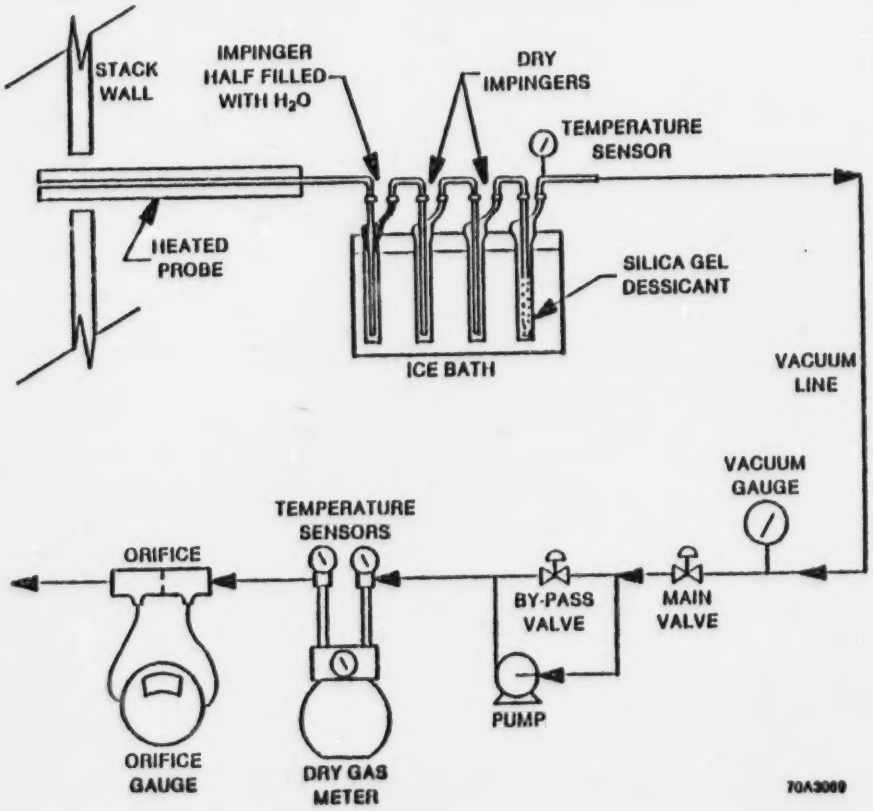

Figure 4-2. EPA Method 4 moisture train.

4.1.4 Volumetric Gas Flow Rate Determination

The volumetric gas flow rate of the portion of the incinerator exhaust that exited to the atmosphere was measured using procedures described in EPA Method 2. The main inlet, floor sweep and combustion air flowrates were also measured using Method 2. As prescribed by this method, the volumetric gas flow rate was determined by measuring the cross-sectional area of the duct or stack and the average velocity of the flue gas. The average gas velocity was calculated from the average gas velocity pressure (ΔP), the average flue gas temperature, wet molecular weight, and the absolute pressure in the stack. Temperature and ΔP profiles were obtained by traversing the stack.

Temperature profile and ΔP data were collected at each of the sampling points using a K-type thermocouple and an S-type pitot tube. A gauge oil manometer was used to measure the pressure drop (ΔP) across the S-type pitot. The daily barometric pressure was obtained from a local weather station and corrected for elevation. The static gas pressure at the incinerator inlet and outlet was be measured by disconnecting one side of the S-type pitot and rotating it so it was perpendicular to the gas flow. A gauge oil manometer was used to measure the static pressure at this point in the duct.

4.1.5 Process Data

In addition to VOC concentrations, moisture contents and volumetric flow rates, several process parameters were determined or obtained at various points in the incinerator. These parameters included pressure drops across each stage of the system, intermediate temperatures, and combustion air and fuel parameters. These additional parameters and the methods which were used for their quantitation are presented in Table 4-2. In many instances, these data were obtained from the plant.

TABLE 4-2. ADDITIONAL INCINERATOR PROCESS PARAMETERS FOR PERFORMANCE EVALUATION

Stream	Parameter	Test Method
Incinerator Auxiliary Fuel	Type	Plant Data
	Composition	Plant Data
	Heating Value	Plant Data
	Rate	Plant Data
Combustion Air	VOC Content	Draft EPA Method 18 and EPA Method 25A
	Rate	Plant Data
Exhaust Gas or Stack Incinerator	Velocity Profile	EPA Methods 1, 2, 3[a] and 4
	Temperature Profile	
Heat Recovery Data	Inlet/Outlet Temperatures	Thermocouple

[a]Molecular weight was determined using a Fyrite for O_2 and the Byron 401 for CO_2. Nitrogen was calculated by difference.

4.2 ANALYTICAL PROCEDURES

This section details the analytical methodology Radian used to characterize operational conditions and to measure the destruction efficiency of the Plant C-6 incinerator. EPA reference methods were used where applicable. Any non-reference method or modifications of reference methods are discussed in this section. An analytical methods matrix is presented in Table 4-3.

4.2.1 Determination of VOC Concentrations

On-site VOC determinations were accomplished using two methods, EPA Method 25A and the draft Method 18. The first method uses flame ionization detection (FID) to provide total hydrocarbon (THC) concentrations. Similarly, the second method also uses an FID for quantification; however, the various organic species in the gas sample are chromatographically separated prior to detection.

4.2.1.1 EPA Method 25A--

Method 25A specifies that THC determinations be performed using a continuous monitor equipped with an FID. Although an FID was used on this project, monitoring was performed on a semi-continuous basis using two Byron THC analyzers, one connected to the incinerator inlet sampling manifold and one to the outlet.

A Byron 301 THC analyzer was used to measure inlet THC concentrations. The Byron Model 301 Hydrocarbon Analyzer is a non-specific process gas chromatograph (GC) utilizing a flame ionization detector (FID) system to quantitatively determine methane (CH_4) and non-methane hydrocarbons in the vapor phase. Zero grade air and hydrogen are used for the flame while zero grade air is the GC column carrier gas. The analyzer contains sufficient hardware to provide sample valve and column valve switching at pre-set times. The instrument used for this testing was set to take a sample every three-minutes.

TABLE 4-3. ANALYTICAL PROCEDURES MATRIX

Parameter to be Measured	Method
VOC Concentration	EPA Method 25A Draft EPA Method 18 GC/MS Analysis
Fixed Gases (Molecular Weight)	Fyrite and Byron 401 Analyzer
Moisture	EPA Method 4
Velocity/Volumetric Flow Rate[a]	EPA Methods 1 and 2
Temperature[a]	Thermocouple
Pressure[a]	Magnehelic® Gauge or Manometer
Other Process Data[a]	Plant Monitors or O&M Records

[a]Discussed in detail in Sections 4.1.4 and 4.1.5.

At the beginning of a cycle, an internal contact closure allows the pressure in the sample loop to equilibrate to atmospheric pressure. Twelve seconds into the cycle, the sample inject valve actuates. Gas in the sample loop is swept into a stripper column where CH_4 is separated from other organic compounds. After the CH_4 elutes from the column and passes through the detector, the non-methane hydrocarbons (NMHC) are backflushed out of the column and through the detector. Figure 4-3 is a schematic flow diagram of the Byron 301 instrument which shows the sample path through the instrument.

The electronics in the instrument provide fixed time peak detection windows, auto zeroing and peak integration capabilities. For six seconds after each peak window opens, the detector signal is monitored and auto zeroing occurs. During the remainder of each peak window, the detector signal is amplified and passed to a storage capacitor to accumulate the total charge from the detector. The amplified signal is continuously monitored with a strip chart recorder. At the end of the peak window, a signal representing the integrated area of the peak (the accumulated charge) is transferred to a capacitor. This charge is used as the input to a computer data acquisition system and remains there until completion of the peak window for the next cycle.

Panel controls on the Byron 301 allow for a VOC range selection of 2 to 20,000 ppm, amplifier gain settings over a wide range, and detector zeroing. The gain setting potentiometers allow calibration of the instrument to provide any specified area value for the standard. For example, a 100 ppm standard can be analyzed to yield an integrated area corresponding to a 100 percent of the full-scale attenuation. In this case, calibration represents a convenient way to determine accurate hydrocarbon concentrations over the full-scale range, i.e., an area of 100 would represent 100 ppm, an area of 50 would represent 50 ppm, and so on.

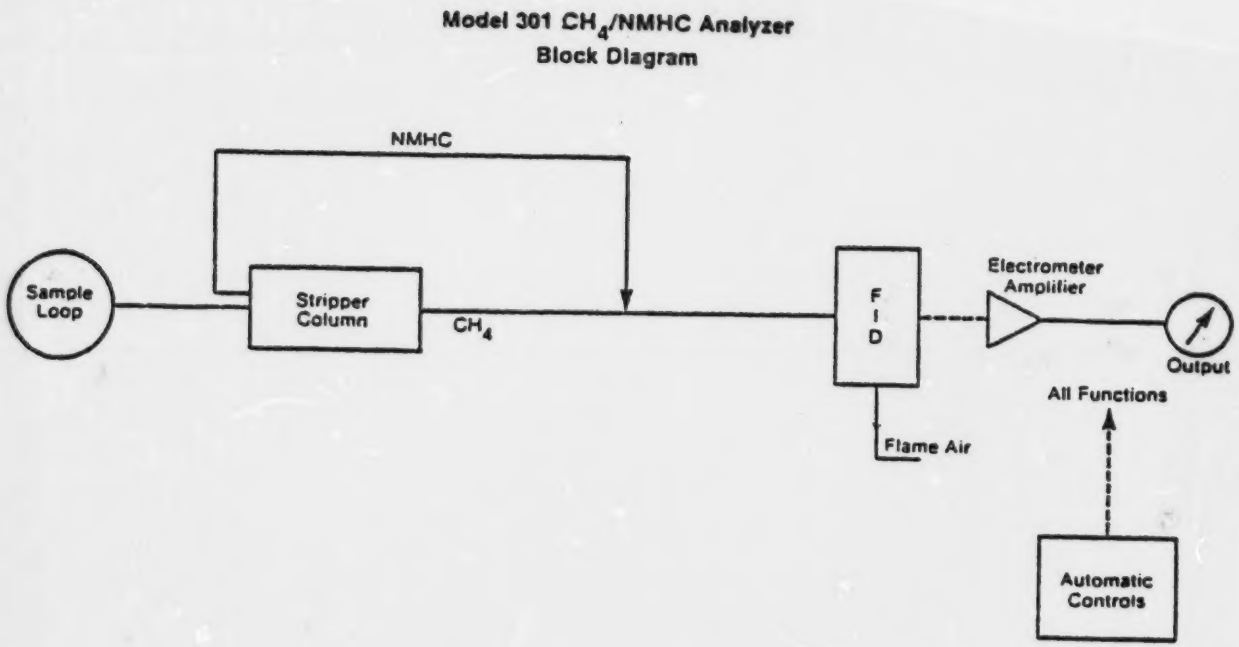

Figure 4-3. Schematic diagram of Byron 301 sample path.

A Byron 401 was used to measure THC and carbon monoxide (CO) in the incinerator outlet stream. The Byron Model 401 Total Emissions Analyzer is similar in many respects to the model 301 described in the above section. The 401 has the additional capability of analyzing a sample stream for total hydrocarbons (THC), nonmethane hydrocarbons, carbon dioxide (CO_2), methane, and carbon monoxide (CO). The instrument was operated mostly in the THC mode because the one-minute cycle time allowed measurement of relatively rapid concentration changes. The full scan mode was operated for brief periods to obtain measurements of CO and CH_4 in the outlet gas.

At the beginning of a THC cycle, contact closure occurs to allow the sample loop to equilibrate to atmospheric pressure. After 12 seconds, a sample is injected and flows directly into the FID. Electronic measurement of this peak and its area proceeds as described above for the Byron 301. The cycle repeats after one minute. Figure 4-4 is a schematic flow diagram of the Byron 401 that indicates the sample path through the instrument. Both the THC sample mode and the full scan mode are shown.

In the full scan mode, the cycle time is 12 minutes. The gas sample introduced into the 401 is ultimately separated into five groups of compounds:

- total hydrocarbons,
- C_3+ hydrocarbons,
- carbon monoxide (CO) and methane (CH_4),
- carbon dioxide (CO_2), and
- the C_2 hydrocarbon group.

In operation the full scan cycle proceeds by first stripping the C_3+ group out of the sample contained in the sample loop. This is done using a chromatographic column which retains C_3+ compounds while allowing the remainder to pass through to a separation column. Meanwhile, the separation column separates the balance of the sample into the remaining three groups.

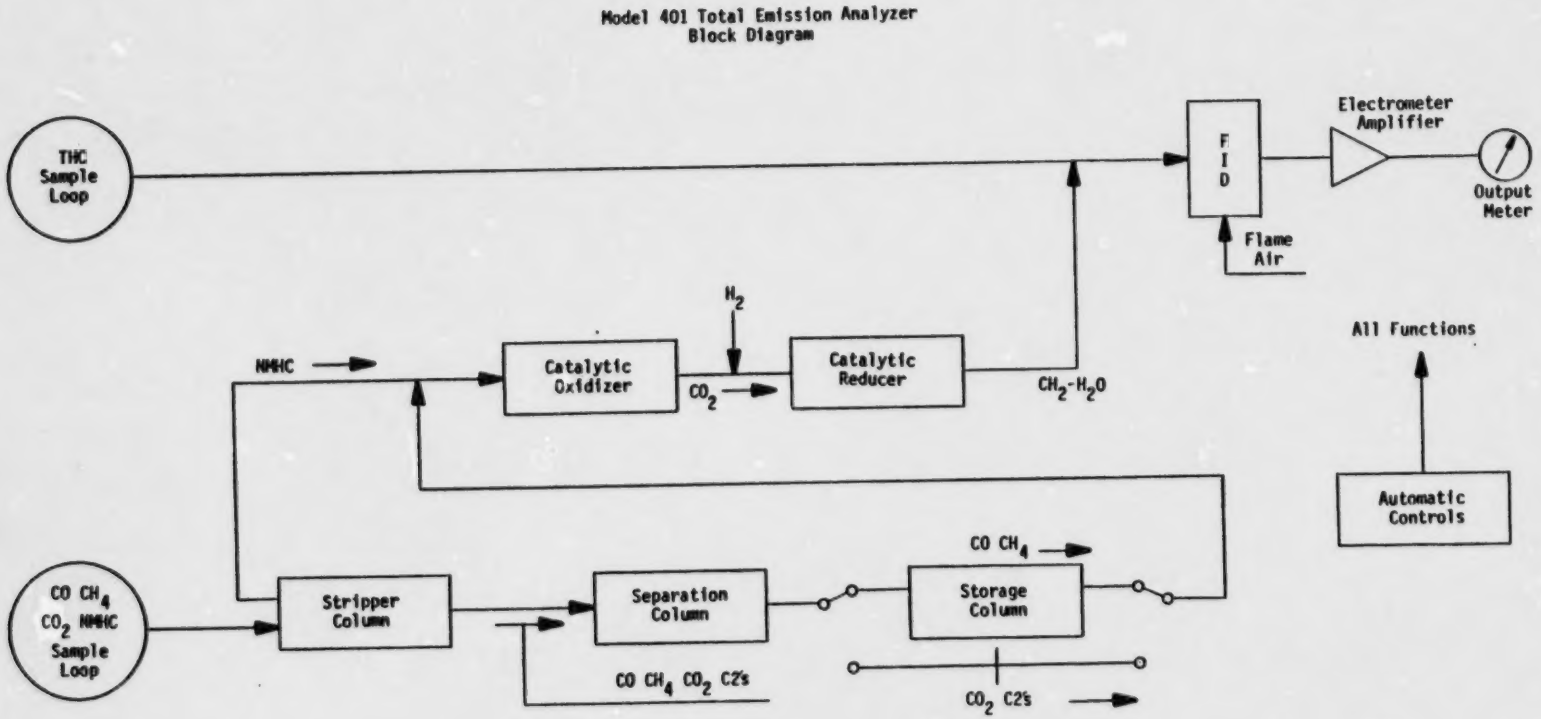

Figure 4-4. Schematic Diagram of Byron 401 Sample Path.

CO and CH_4 emerging from the separator are retained on a 5A molecular sieve storage column while the CO_2 and C_2 groups are eluted. CO and CH_4 are then resolved and follow the same path to the FID where they are measured separately as CH_4.

All data from the Byron instruments were automatically recorded, stored on disk, and reduced using an Apple^R II minicomputer. The computer also recorded the date and time of analysis, instrument, and sampling location. As a backup to the minicomputer data acquisition system, integrated areas of the peaks generated by each instrument were recorded using a strip chart recorder.

4.2.1.2 Method 18--

The draft Method 18 differs from Method 25A in that sample acquisition may be performed either by direct interface or by grab sampling. In addition, the organic species content in the stream is chromatographically speciated prior to detection by FID.

The draft Method 18 provides for the individual quantitation of organic species by gas chromatography using a flame ionization detector (FID). These analyses were performed on the same sample gas used for Method 25A. Analyses were performed simultaneously with the Method 25A analyses whenever possible. The gas sample was introduced into a fixed volume sample loop on an oven-mounted, 10-port stainless steel valve. After the loop was flushed with at least a 100-fold volume of sample, the gas flow was stopped and the loop was allowed to come to atmospheric pressure. The valve was then switched to the inject position. The instrument and analytical conditions used were:

- Instrument: Tracor Model 560
- Column: 6 ft. x 1/8 od s.s., Poropak Q^R, 50/80 mesh
- Carrier Gas: Nitrogen at 25 mL/min

- Temperature Program: 150°C for 2 min, 10°C/min to 220°C, 250°C until elution is complete
- Injection: 5 mL fixed volume loop
- Detector 300°C

4.2.1.3 GC-MS Method--

Organic species were identified by GC/MS analysis of 20-minute, integrated samples taken in evacuated canisters. This system allows the identification of low molecular weight organics in the inlet and exhaust streams. The GC/MS uses a cryogenic trap to isolate sample components. The analytical conditions are summarized in Table 4-4. The cryogenic trapping system which was used is microprocessor controlled with air actuated valves to maximize analytical reproducibility.

4.2.2 Determination of Fixed Gases (Molecular Weight)

The molecular weight of the incinerator outlet stream was determined using a combination of two methods, a Fyrite^{R} apparatus and a Byron 401 analyzer. The oxygen content of the outlet stream was determined using an oxygen Fyrite^{R} apparatus. Gas sample for oxygen analysis was drawn directly from the outlet sampling port. The carbon dioxide content of the outlet stream was measured using the Byron 401 analyzer in the full scan mode. Gas sample for CO_2 analysis was drawn from the Method 25A sampling manifold. The nitrogen content of the outlet stream was determined by difference.

4.2.3 Determination of Moisture Content

The moisture content of the incinerator inlet and exhaust streams was determined using the methodology described in EPA Method 4. By this method, a measured volume of particulate-free gas is pulled through a chilled impinger train. The quantity of water condensed in the impingers is determined gravimetrically and then related to the volume of gas sampled to determine the moisture content.

TABLE 4-4. GC-MS CONDITIONS FOR ANALYSIS OF CANISTER SAMPLES

GC-MS Conditions	
Instrument	Hewlett-Packard Model 5982
Ionization voltage	70 eV
Scan rate	1 scan/sec
Scan range	10-200 amu
Column	25 meter DB-5 Fused Silica wide bore thick film
Initial temperature	-50°C
Program rate	16°C/min
Final temperature	280°C
Interface	Open split coupled
Trap Conditions	
Cryogenic trap temperature	-183°C
Desorption temperature	190°C
Desorption time	>10 min

SECTION 4 REFERENCES

1. EPA Proposed Method 25A, "Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer," Proposed Revision to Appendix A 40 CFR, Federal Register, Volume 45, Number 194, December 17, 1980. pp. 83149-83151.

2. EPA Draft Method 18, "Measurement of Gaseous Organic Compound Emissions by Gas Chromatography," Personal communication with Jeff Chappell, U.S. Environmental Protection Agency, IERL-RTP.

3. EPA Reference Method 3, "Gas Analysis for Carbon Dioxide, Oxygen, Excess Air, and Dry Molecular Weight," Appendix A to 40 CFR, Environmental Reporter, Bureau of National Affairs, Washington, D.C., December 5, 1980. pp. 33-36.

4. EPA Reference Method 4, "Determination of Moisture Content in Stack Gases," Appendix A to 40 CFR, Environmental Reporter, Bureau of National Affairs, Washington, D.C., December 5, 1980. pp. 36-41.

5. EPA Reference Method 2, "Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube), Appendix A to 40 CFR, Environmental Reporter, Bureau of National Affairs, Washington, D.C., December 5, 1980. pp. 25-33.

SECTION 5

RESULTS OF TESTING AND ANALYSIS

The catalytic incinerator at Plant C-6 was tested from February 25 through March 4, 1983. Data collected on the incinerator showed a narrow range of destruction efficiencies, 95.3 to 97.8 percent, over a fairly wide range of operating conditions. Incinerator operating temperature and inlet total hydrocarbon (THC) mass flowrate were the major parameters affecting performance. Limited data suggest that solvent laden air (SLA) residence time may also be an important operating parameter.

Data at Plant C-6 were collected on six different products or coatings. These products are identified in this section as Products A through F. The results of the testing are presented in this section. Operating parameters and VOC sampling results are discussed in Sections 5.1 and 5.2, respectively.

5.1 OPERATING PARAMETERS

The operating parameters measured or recorded during the testing are discussed in this section. Data collected on operating conditions are shown in Table 5-1. The data include gas temperatures, gas flowrates, pressure drops and incinerator energy consumption.

Gas temperatures shown in Table 5-1 were measured with type K thermocouples and recorded on a continuous multipoint strip chart recorder. The catalyst inlet temperature was intentionally varied for Products B and E to characterize the effect of temperature on incinerator performance. Gas flowrates were measured according to EPA Method 2. Stack gas flowrates were

TABLE 5-1. SUMMARY OF INCINERATOR OPERATING PARAMETERS - PLANT C-6

Parameter	Average Value	Range
Catalyst inlet temperature	291°C (556°F)	252-341°C (485-645°F)[a]
Catalyst outlet temperature	421°C (790°F)	335-474°C (635-885°F)[a]
Main inlet SLA flowrate	4.51 Nm^3/s (9553 dscfm)	4.44-4.61 Nm^3/s (9410-9780 dscfm)[b]
Main inlet SLA gas temperature	158°C (316°F)	118-176°C (244-348°F)
Floorsweep flowrate	0.44 Nm^3/s (925 dscfm)	0.39-0.48 Nm^3/s (818-1015 dscfm)
Floorsweep gas temperature	27°C (81°F)	23-29°C (74-84°F)
Combustion air flowrate	0.13 Nm^3/s (285 dscfm)	--
Stack gas flowrate[c]	2.4 Nm^3/s (5040 dscfm)	2.1-2.9 Nm^3/s (4360-6140 dscfm)
Stack gas temperature[c]	357°C (674 °F)	307-389°C (585-733°F)
Stack gas moisture content[c]	4.1%	3.8-4.3%
Catalyst bed pressure drop[d]	0.42 kPa (1.7 "H_2O)	0.30-0.47 kPa (1.2-1.9 "H_2O)
Filter pressure drop[d]	0.35 kPa (1.4 "H_2O)	0.22-0.37 kPa (0.9-1.5 "H_2O)
Burner pressure drop[d]	0.10 kPa (0.4 "H_2O)	0.07-0.12 kPa (0.3-0.5 "H_2O)
Venturi pressure drop[d]	2.3 kPa (9.4 "H_2O)	1.7-2.5 kPa (6.9-10.2 "H_2O)
Natural gas usage[e]	0.010 m^3/s (21.5 cfm)	0.007-0.012 m^3/s (14.1-26.1 cfm)
Natural gas energy usage[f]	$2.80_6 \times 10^9$ J/hr (2.65 $\times 10^6$ Btu/hr)	$1.88_6 \times 10^9$-$3.48_6 \times 10^9$ J/hr (1.78 $\times 10^6$-3.30 $\times 10^6$ Btu/hr)
Fan energy usage[g]	60.9 kW	--
Percent gas recirculation[h]	54%	43-60%

[a] The temperature was varied over this range to characterize incinerator performance under different conditions.

[b] Main inlet flowrate of 3.58 Nm^3/s (7590 scfm) was measured on 2/25/83.

[c] For roof stack venting to atmosphere.

[d] From plant instrumentation.

[e] From natural gas meter during testing.

[f] Based on gas pressure of 17 psig and heating value of 1000 Btu/scf.

[g] Design value at full load. Includes both main SLA blower and two recycle blowers.

[h] Calculated as percent of total incinerator outlet gas flow recirculated to the drying oven.

higher at higher incinerator operating temperatures and the percent gas recirculation was lower. The gas sampling locations are shown in Figure 5-1.

The main inlet flowrates shown in Table 5-1 are based on measurements taken after 2/25/83. On 2/25/83 a main inlet flowrate of 3.58 Nm^3/s (7590 dscfm) was measured. The flowrate was lower on this day because the incinerator inlet SLA thermocouple was not in the inlet duct. As discussed in Section 3.2, the inlet SLA flowrate is controlled by the pressure drop across a venturi flow meter and the inlet SLA temperature. During the period when the inlet SLA thermocouple was out of the duct, the controller maintained the main inlet flowrate at a value 20 percent below normal. This resulted in an increase of the SLA residence time in the catalyst bed from approximately 0.029 to 0.036 seconds. The thermocouple was outside the duct during the test periods from 1700-2130 on 2/25 and 0700-0800 on 2/28.

Pressure drops presented in Table 5-1 for the catalyst, filter, burner and venturi were obtained from plant instrumentation. Natural gas usage was determined from an existing gas meter on the incinerator. Fan energy usage is based on the design amperage at full load. The actual fan energy usage is probably somewhat below this value.

Energy usage and heat recovery data for Plant C-6 are shown in Table 5-2 as measured for different products and different incinerator operating temperatures. Also shown are main inlet SLA flowrates and the corresponding venturi pressure drops for these flowrates.

The heat recovery rates shown in Table 5-2 were calculated as the percent of heat generated in the incinerator that does not exit with the roof stack exhaust gas. Heat generation in the incinerator results from both natural gas and solvent combustion. The heat recovery rates range from 25 to 36 percent. An example of the calculation is presented in Appendix E.

TABLE 5-2. SUMMARY OF ENERGY USAGE AND HEAT RECOVERY PARAMETERS - PLANT C-6.

Date	Time	Product ID	Stack Gas Flowrate[a] Nm^3/s (scfm)	Heat Recovery Rate (%)[b]	Average Gas Temperature °C (°F)			Natural Gas Energy Usage J/hr (Btu/hr)	Main Inlet SLA Flowrate m^3/s (acfm)	Venturi ΔP ("H_2O)
					Incinerator Inlet	Catalyst Bed Inlet	Burner ΔT			
2/28/83	1550	B	2.06 (4363)	36	174 (345)	285 (545)	111 (200)	2.35×10^9 (2.23×10^6)	7.28 (15,440)	10.1
2/28/83	1836	B	2.09 (4426)	35	171 (340)	277 (530)	106 (180)	2.33×10^9 (2.21×10^6)	7.40 (15,690)	10.2
3/1/83	1840	A	NA[c]	NA	177 (350)	285 (545)	108 (195)	1.88×10^9 (1.78×10^6)	7.41 (15,720)	10.2
3/2/83	1022	B	2.42 (5140)	30	168 (335)	338 (640)	170 (305)	3.07×10^9 (2.91×10^6)	7.14 (15,130)	9.9
3/3/83	1710	D	2.35 (4985)	30	141 (285)	288 (550)	147 (265)	3.08×10^9 (2.92×10^6)	6.58 (13,960)	9.3
3/3/83	2210	B	2.44 (5180)	29	157 (315)	341 (645)	184 (330)	3.48×10^9 (3.30×10^6)	7.11 (15,070)	9.8
3/4/83	1832	E	2.90 (6138)	25	121 (250)	277 (530)	156 (280)	3.41×10^9 (3.23×10^6)	6.33 (13,410)	8.9

[a]For roof stack venting to atmosphere.

[b]Calculated as percent of heat generated in the incinerator by natural gas and solvent combustion that does not exit with the roof stack exhaust gas.

[c]Not available.

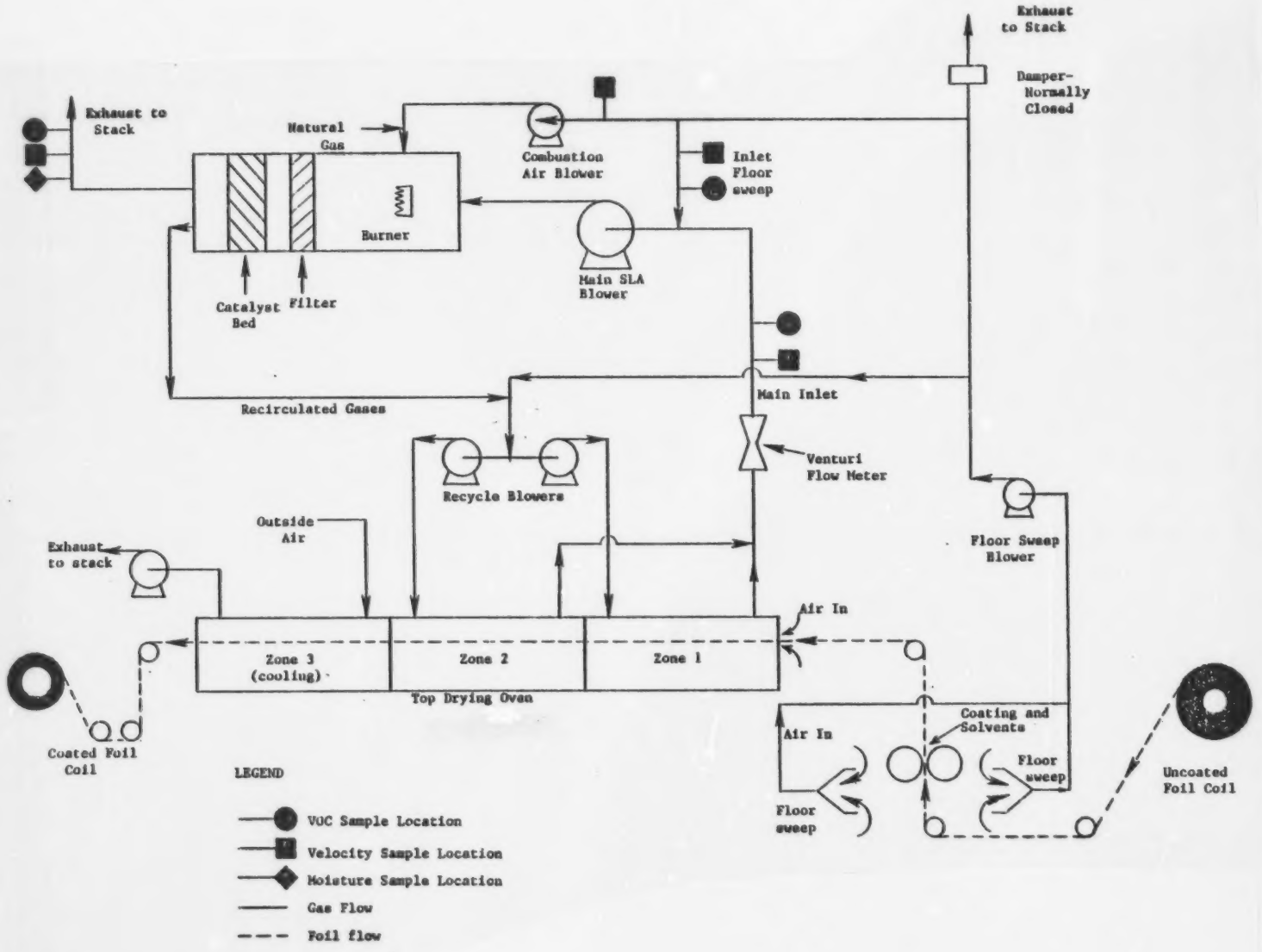

Figure 5-1. Sampling locations for Plant C-6.

Figure 5-1. Sampling locations for Plant C-6

5.2 VOC SAMPLING AND ANALYSIS RESULTS

The results of Method 25A and Method 18 analyses performed at Plant C-6 are presented in this section. A summary of the Method 25A results is presented first, followed by a discussion of the effect of major operating parameters on incinerator performance. Method 18 results are discussed last.

Inlet and outlet concentrations presented in this section are expressed in parts per million by volume as carbon (ppmv). The destruction efficiencies are based on inlet and outlet THC mass flowrates. The THC mass flowrates were determined using gas flowrates presented in Section 5.1 and the measured THC concentrations. An example calculation of destruction efficiency is given in Appendix E.

5.2.1 Summary of Method 25A Results

A summary of the Method 25A or total hydrocarbon (THC) analysis results is presented in Table 5-3. Over 38 hours of THC data were collected during normal coater operation between 2/25/83 and 3/4/83. The monitoring period and the length of the monitoring period is identified in the table.

All of the data shown in Table 5-3 represent normal incinerator and coater operation. The incinerator was shut down during employee breaks and for product changeovers. Upon startup of the coating line, the inlet THC concentration increased to a relatively steady state value within several minutes. Data collected during this brief startup period are included in the average values presented in Table 5-3.

Data are shown in Table 5-3 for six different coatings, a wide range of inlet concentrations, two incinerator operating temperatures and two solvent laden air (SLA) residence times. Products A, B, D, and E all had similar solvent compositions, consisting of about a 50/50 mixture of methyl ethyl ketone (MEK) and toluene by weight. Product D also contained a small

TABLE 5-3. SUMMARY OF EPA METHOD 25A RESULTS - PLANT C-6

Date	Monitoring Period	Length of Monitoring Period	Product ID	Main Inlet THC Concentration[a] (ppmv)	Floor Sweep THC Concentration[a] (ppmv)	Outlet THC Concentration[a] (ppmv)	THC Mass Flowrates Inlet kg/hr (lb/hr)	THC Mass Flowrates Outlet kg/hr (lb/hr)	Destruction Efficiency[k] (%)	Catalyst Inlet Temperature °C (°F)	Catalyst Outlet Temperature °C (°F)
2/25/83	17:02-18:06[b]	65	F	8006	--	201	71.2 (157)	2.0 (4.3)	97.3	285 (545)	393 (740)
2/25/83	20:53-21:34[b]	42	F	8811	--	199	78.0 (172)	1.9 (4.2)	97.6	285 (545)	396 (745)
2/28/83	07:25-08:11[b]	47	B	11125	--	263	98.0 (216)	2.5 (5.6)	97.4	285 (545)	416 (780)
2/28/83	14:06-15:06	66	B	10947	--	291	96.2 (212)	2.8 (6.2)	97.1	285 (545)	427 (800)
2/28/83	15:39-17:37	118	B	10830	2382[c]	294	94.8 (209)	2.8 (6.2)	97.0	282 (540)	416 (780)
2/28/83	18:13-19:40	87	B	10926	2596[d]	305	96.2 (212)	3.0 (6.5)	97.0	277 (530)	418 (785)
2/28/83	19:47-20:57	72	B	10970	--	290	96.6 (213)	2.8 (6.2)	97.1	277 (530)	418 (785)
2/28/83	21:47-22:04	18	B	10217	--	291	90.3 (199)	2.8 (6.2)	96.9	277 (530)	418 (785)
3/1/83	13:58-15:00	63	A	11514	--	287	101 (223)	2.8 (6.1)	97.3	274 (525)	421 (790)
3/1/83	17:11-18:24	74	A	12864	--	295	112 (248)	2.9 (6.3)	97.5	285 (545)	443 (830)
3/1/83	19:56-20:59	64	A	12504[e]	2592[f]	286	109 (241)	2.8 (6.1)	97.5	282 (540)	435 (815)
3/1/83	22:06-23:36	91	A	12303	--	289	108 (238)	2.8 (6.2)	97.4	285 (545)	438 (820)
3/2/83	00:31-02:30	93	A	12505	--	293	109 (241)	2.8 (6.2)	97.4	285 (545)	446 (835)
3/2/83	04:38-06:38	123	B	10183	--	280	89.8 (198)	2.7 (5.9)	97.0	282 (540)	421 (790)
3/2/83	07:13-08:50	100	B	11200	--	293	98.4 (217)	2.8 (6.2)	97.1	282 (540)	438 (820)
3/2/83	09:33-11:14	102	B	12358	--	250	108 (239)	2.4 (5.3)	97.8	338 (640)	474 (885)
3/2/83	12:32-14:02	91	B	10122	--	218	89.4 (197)	2.1 (4.7)	97.6	341 (645)	457 (855)
3/2/83	19:37-21:21	64[g]	C	8806	--	286	78.0 (172)	2.8 (6.1)	96.5	274 (525)	424 (795)
3/3/83	09:32-11:04	93	D	6485	--	269	58.1 (128)	2.6 (5.7)	95.5	252 (485)	335 (635)
3/3/83	11:44-12:15	32	D	6222	--	272	55.8 (123)	2.6 (5.8)	95.3	254 (490)	341 (645)
3/3/83	15:56-17:11	76	D	6542	2452[h]	248	58.5 (129)	2.4 (5.3)	95.9	288 (550)	374 (705)
3/3/83	20:15-00:03	217	B	8794	2888[i]	245	78.0 (172)	2.4 (5.3)	97.0	341 (645)	443 (830)
3/4/83	00:51-01:57	67	B	9594	--	298	84.8 (187)	2.9 (6.3)	96.6	279 (535)	407 (765)
3/4/83	02:43-05:06	144	B	9467	--	299	83.9 (185)	2.9 (6.4)	96.5	285 (545)	407 (765)
3/4/83	05:40-07:55	136	B	9212	--	295	81.7 (180)	2.9 (6.3)	96.5	285 (545)	407 (765)
3/4/83	17:32-20:21	95	E	11244	2372[j]	279	98.4 (217)	2.7 (5.9)	97.3	277 (530)	435 (815)
3/4/83	21:27-22:09	43	E	11101	--	250	97.1 (214)	2.4 (5.3)	97.5	307 (585)	424 (795)

[a] ppmv = parts per million by volume as carbon C_1 quanitated against propane. Gas sampling locations are shown in Figure 5-1.

[b] Data collected during these periods represent a SLA residence time of approximately 0.036 sec. All other data represent a residence time of 0.029 sec.

[c] Based on 6 minutes of data analysis.

[d] Based on 63 minutes of data analysis.

[e] Inlet concentration based on 15 minutes monitoring during this period.

[f] Based on 42 minutes of monitoring.

[g] Process down period not included in average.

[h] Based on 9 minutes.

[i] Based on 63 minutes of data.

[j] Based on 39 minutes of data.

[k] Destruction Efficiency $= \frac{Min - Mout}{Min} \times 100\%$, where

$$M = \text{THC Mass Rate} = \frac{(V) \text{ moles C}}{10^6 \text{ moles gas}} \times \frac{12 \text{gC}}{\text{mole C}} \times \frac{\text{mole gas}}{0.024 \text{ m}^3 \text{ gas}} \times \frac{(Q) \text{ m}^3 \text{ gas}}{\text{sec}}$$

V = THC concentration (inlet or outlet); ppmv

Q = gas flowrate (inlet or outlet), Nm^3/sec

amount of isopropanol, n-butyl alcohol, xylene and cellosolve acetate. The solvent in Products F and C was 100 percent MEK.

Main inlet, floorsweep and incinerator outlet THC concentrations as well as inlet and outlet THC mass flowrates are shown in Table 5-3. Gas sampling locations are shown in Figure 5-1. The inlet THC mass flowrate was calculated as the sum of the main inlet, floorsweep and combustion air THC mass flowrates. The floorsweep and combustion air have the same THC concentration.

Destruction efficiencies measured at Plant C-6 varied over a relatively narrow range, from 95.3 to 97.8 percent. The lowest efficiencies were measured for Product D at catalyst bed inlet temperatures of approximately 254°C (490°F). The highest efficiencies were for Product B at a catalyst inlet temperature of 338°C (640°F).

Inlet THC mass flowrates for the Plant C-6 incinerator varied widely from 56 to 112 kg/hr (123 to 248 lb/hr). However, outlet THC mass flowrates were fairly constant, varying from 1.9 to 3.0 kg/hr (4.2 to 6.5 lb/hr).

Carbon monoxide (CO) and carbon dioxide (CO_2) concentrations were measured for approximately 3.5 hours during the test period. Values for CO ranged from 1 to 4 ppmv and values for CO_2 ranged from 1.7 to 1.9 percent.

5.2.2 Effect of Major Operating Parameters on Incinerator Performance

Four parametric analyses were performed on the Method 25A data presented in Section 5.2.1 to assess the effect of major operating parameters on incinerator performance. The four analyses include:

- the effect of operating temperature on destruction efficiency,
- the effect of inlet THC mass flowrate on destruction efficiency,

- the effect of residence time on destruction efficiency, and

- the effect of the mass of solvent burned on catalyst bed temperature rise.

The results of these parametric analyses are presented in this section.

A statistical validation of the first three parametric analyses listed above has been performed to verify that the functional relationships observed are not a result of measurement data variability (i.e., random sampling error). The results of the statistical validation and the statistical methods used are discussed in detail in the Quality Assurance Report for this program.[1] Conclusions presented in this section regarding the effect of operating parameters on performance were found to be statistically valid at a confidence level of 95 percent.

Effect of Temperature--The effect of catalyst inlet temperature on destruction efficiency is shown in Table 5-4 for different products at constant inlet THC mass flowrates. Both average destruction efficiencies and 95 percent confidence intervals are shown. In all cases increasing the catalyst inlet temperature caused a slight increase in the average destruction efficiency.

The dependence of destruction efficiency on temperature appears to be relatively weak for the range of conditions tested at Plant C-6. Increasing the catalyst inlet temperatures from between 30 and 59°C (55 and 105°F) showed destruction efficiency increases between 0.2 and 0.6 percent. These increases, while small, are considered "statistically significant" because the confidence intervals for the compared efficiencies do not overlap. It is highly probable that the efficiency differences observed are not due to random measurement variability.

Typical relationships for destruction efficiency versus inlet temperature show small increases in efficiency with temperature as the efficiency approaches 100 percent.[2] The weak dependence of destruction

TABLE 5-4. COMPARISON OF CATALYST INLET TEMPERATURE VS. DESTRUCTION EFFICIENCY - PLANT C-6.

Date	Time	Product	Incinerator Inlet THC Mass Flowrate kg/hr (lb/hr)	Catalyst Inlet Temperature °C (°F)	Outlet THC Concentration ppmvC	Average Destruction Efficiency (%)	Approximate 95% Confidence Interval[a]
3/2/83	0438-0638	B	89.8 (198)	282 (540)	280	97.0	96.9, 97.1
3/2/83	1232-1402		89.4 (197)	341 (645)	218	97.6	97.5, 97.7
3/4/83	0540-0755	B	81.7 (180)	285 (545)	295	96.5	96.4, 96.6
3/3/83	2015-0003		78.0 (172)	341 (645)	245	97.0	96.9, 97.1
3/3/83	0932-1104	D	58.1 (128)	252 (485)	269	95.5	95.2, 95.8
3/3/83	1556-1711		58.5 (129)	288 (550)	248	95.9	95.8, 96.0
3/4/83	1732-2021	E	98.4 (217)	277 (530)	279	97.3	97.2, 97.4
	2127-2209		92.1 (214)	307 (585)	250	97.5	97.4, 97.6

[a]Confidence interval based on measurement variability (i.e., random sampling error).

efficiency on temperature at Plant C-6 is, therefore, somewhat expected because the efficiencies exceed 95 percent.

Outlet THC concentrations and the corresponding stack emission rates were more significantly affected by the temperature variations. Increasing the inlet temperatures from between 30 and 59°C (55 and 105°F) caused outlet THC concentration reductions ranging from 8 to 20 percent.

Effect of Inlet THC Mass Flowrate--The effect of inlet THC mass flowrate on destruction efficiency is shown in Tables 5-5 and 5-6. Both average destruction efficiencies and 95% confidence intervals are presented. Data for different products with similar catalyst inlet temperatures are shown in Table 5-5 and data for Product B at two catalyst inlet temperatures are shown in Table 5-6.

The data in Tables 5-5 and 5-6 show a trend of increasing destruction efficiency with increasing THC mass flowrate. This trend is illustrated in Figure 5-2. At a catalyst inlet temperature of approximately 285°C (545°F), the destruction efficiency increased from 95.9 to 97.5 percent as the inlet THC mass flowrate increased from 58.5 to 109 kg/hr (129 to 241 lb/hr).

The increase in destruction efficiency with increasing inlet THC mass flowrate results from an increase in the overall reaction rate between the solvent and oxygen in the gas stream. The increase in the overall reaction rate results from either an increase in the chemical reaction rate for the solvent and oxygen on the catalyst surface or the rate of mass transfer of solvent to the catalyst surface.[3]

Due to the short service life of the catalyst tested at Plant C-6, it is likely that the catalyst is still highly active and that the overall reaction is not chemical (surface) reaction rate limited. If the overall reaction is solvent mass transfer limited, then increased inlet THC concentration would be expected to increase the overall reaction rate. The

TABLE 5-5. EFFECT OF INLET THC MASS FLOWRATE ON DESTRUCTION EFFICIENCY FOR DIFFERENT PRODUCTS

Date	Time	Product ID	Inlet THC Mass Flowrate kg/hr	(lb/hr)	Destruction Efficiency, % (95% C.I.)[a]	Catalyst Inlet Temperature °C	(°F)	Catalyst Outlet Temperature °C	(°F)
3/3/83	1556-1711	D	58.5	(129)	95.9 (95.8, 96.0)	285	(545)	374	(705)
3/2/83	1937-2121	C	78.0	(172)	96.5 (96.3, 96.7)	276	(530)	424	(795)
3/28/83	1406-1737	B	95.3	(210)	97.0 (96.8, 97.1)	285	(545)	418	(785)
3/4/83	1732-2021	E	98.4	(217)	97.3 (97.2, 97.4)	276	(530)	435	(815)
3/1-3/2/83	1711-0203	A	109	(241)	97.5 (97.4, 97.6)	285	(545)	441	(825)

[a]Destruction efficiencies based on average values presented in Table 5-3. C.I. = approximate 95% confidence interval based on measurement variability (random sampling error).

TABLE 5-6. EFFECT OF INLET THC MASS FLOWRATE ON DESTRUCTION EFFICIENCY FOR PRODUCT B AT TWO CATALYST INLET TEMPERATURES

Date	Time	Product ID	Incinerator Inlet THC Mass Flowrate kg/hr	(lb/hr)	Destruction Efficiency, [a] % (95% C.I.)	Average Gas Temperature Catalyst Inlet °C	(°F)	Catalyst Outlet °C	(°F)
3/3/83	2015-0013	B	78.0	(172)	97.0 (96.9, 97.1)	341	(645)	443	(830)
3/2/83	1232-1402	B	89.4	(197)	97.6 (97.5, 97.7)	341	(645)	457	(855)
3/2/83	0933-1114	B	108	(239)	97.8 (97.7, 97.9)	338	(640)	474	(885)
3/4/83	0051-0755	B	84.8	(187)	96.6 (96.5, 96.7)	285	(545)	407	(765)
2/28/83	0725-1737	B	98.0	(216)	97.1 (97.0, 97.2)	282	(540)	416	(780)

[a] Destruction efficiencies based on average values presented in Table 5-3. C.I. = approximate 95% confidence interval based on measurement variability (random sampling error).

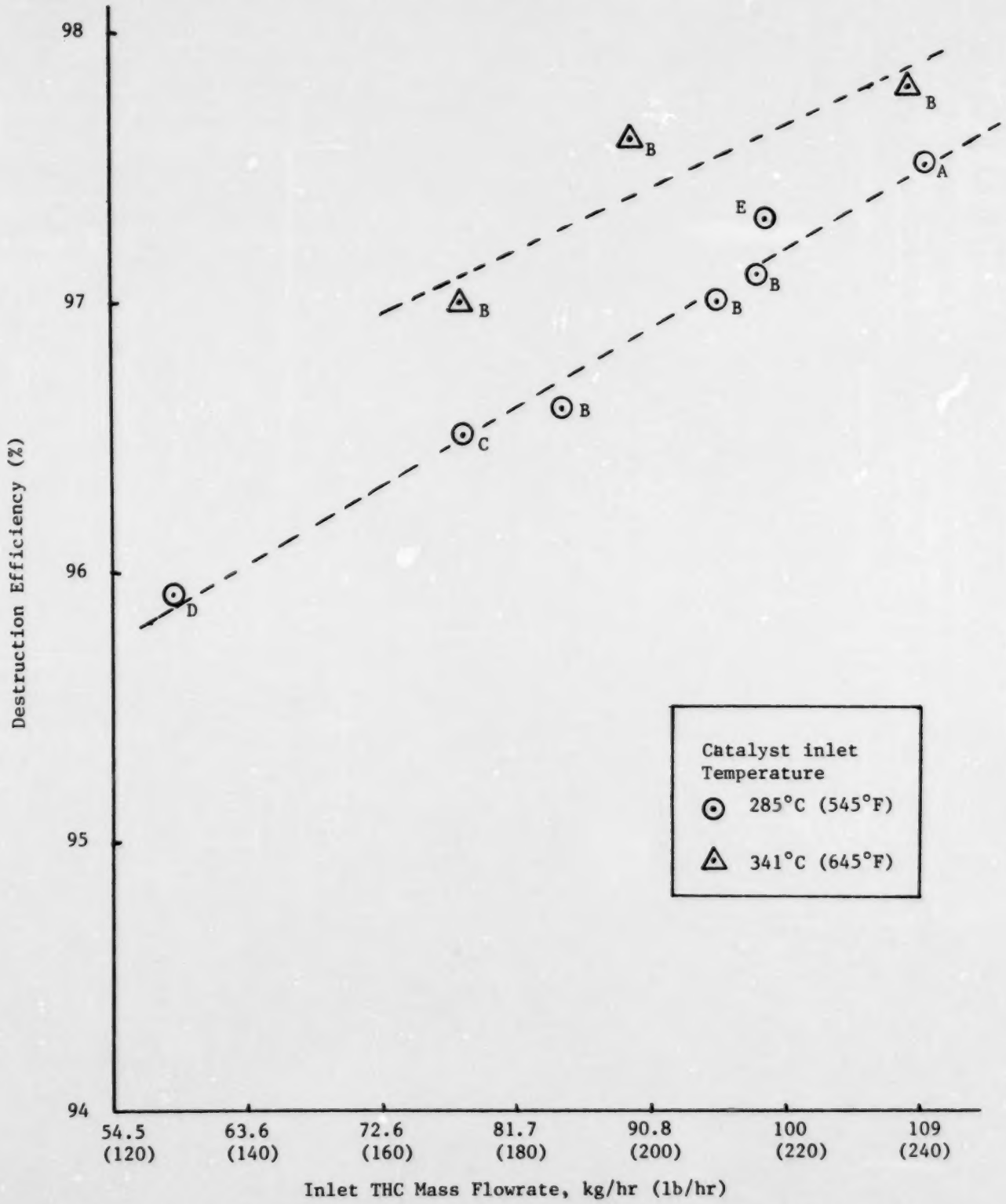

Figure 5-2. Effect of Inlet THC Mass Flowrate on Destruction Efficiency

higher concentration of solvent in the bulk gas would aid mass transfer by creating a greater driving force for the solvent to migrate to the catalyst surface.

Effect of Residence Time--The effect of SLA residence time is shown in Table 5-7 for Products B, C, and F at similar inlet THC mass flowrates and catalyst inlet temperatures. The data for Products C and F should be directly comparable because solvents in both of these products consist of 100 percent methyl ethyl ketone (MEK). Product B was the only product tested at both residence times. As discussed in Section 5.1, the SLA residence time was longer for two monitoring periods because the inlet SLA thermocouple was out of the inlet duct.

The limited amount of data in Table 5-7 suggest that destruction efficiency may increase with increasing catalyst bed residence time. For Product F compared to Product C, a statistically significant increase of 1.1 percent was observed at the longer residence time. A portion of this increase, however, may be attributed to the slightly higher catalyst bed inlet temperature for Product F. For Product B, the measured increase in efficiency (0.3 percent) is not statistically significant.

Additional data at a wider range of residence times would be required to fully assess the effect of residence time on the destruction efficiency of the Plant C-6 incinerator. Higher destruction efficiencies are expected for longer residence times because more catalyst surface area is available per unit volume of gas passing through the incinerator. However, the effect of SLA residence time is expected to decrease as the destruction efficiency approaches 100 percent.[2]

Effect of Mass of Solvent Burned--The effect of the mass of solvent destroyed on the catalyst bed temperature rise is shown in Figure 5-3. The mass of solvent destroyed in Figure 5-3 is the mass of solvent burned across the incinerator. The data in the figure represent 27 monitoring periods for all six products tested at Plant C-6.

TABLE 5-7. EFFECT OF SOLVENT LADEN AIR RESIDENCE TIME ON DESTRUCTION EFFICIENCY

Date	Time	Product ID	Inlet THC Mass Flowrate kg/hr (lb/hr)	SLA Residence Time (Seconds)	Destruction Efficiency[a] % (95% C.I.)	Outlet THC Concentration (ppmv)	Catalyst Inlet Temperature °C (°F)
2/25/83	2053 - 2134	F	78.0 (172)	0.036	97.6 (97.5, 97.7)	199	285 (545)
3/2/83	1937 - 2121	C	78.0 (172)	0.029	96.5 (96.3, 96.7)	286	274 (525)
2/28/83	0725 - 0811	B	98.0 (216)	0.036	97.4 (97.3, 97.5)	263	285 (545)
2/28/83	1406 - 1506	B	96.2 (212)	0.029	97.1 (96.8, 97.3)	291	285 (545)

[a]Destruction efficiencies based on average values presented in Table 5-3. C.I. = approximate 95% confidence interval based on measurement variability (random sampling error).

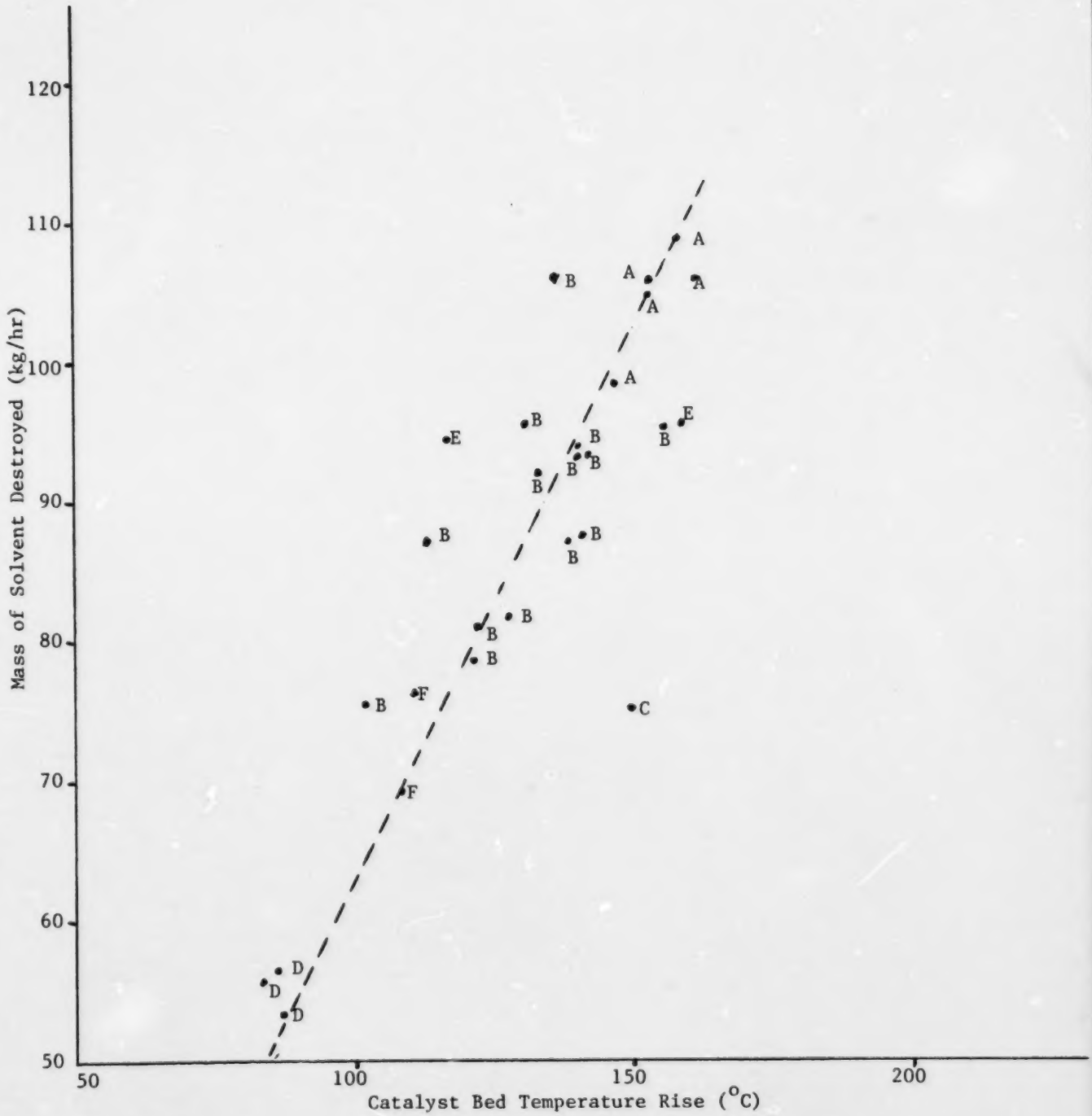

Figure 5-3. Catalyst bed temperature rise versus mass of solvent destroyed - Plant C-6.

As shown in Figure 5-3, there is a linear trend of increasing mass of solvent burned with increasing catalyst bed temperature rise. The dashed line shown in the figure represents the least-square linear fit for the 27 data points and has a correlation coefficient of 0.864.

5.2.3 Results of Method 18 Analysis

Samples of the main inlet, outlet and floor sweep streams were analyzed by gas chromatography to quantitate specific compounds in the gas streams. A summary of the speciation results is presented in Table 5-8. The values in the table represent average concentration and standard deviation in parts per million by volume as carbon. Complete results of gas chromatographic analyses are presented in Appendix C. Results from Table 5-8 show that Product F consists entirely of methyl ethyl ketone (MEK); products A, B and E contain MEK and toluene; and Product D is comprised of MEK, toluene and two additional quantifiable components in the C_4 and C_6 range. Product D also contained two compounds in the C_7+ range which chromatographed poorly. These compounds were detected but could not be measured by the integrator.

Samples of the floor sweep inlet gas were also analyzed for Products B and E. The fugitive VOC emissions captured at the floor sweep contained a much higher percentage of MEK than the main inlet gases. For Product B, the main inlet consisted of approximately 45 percent MEK and 55 percent toluene. The corresponding floor sweep inlet contained 70 percent MEK and 30 percent toluene. Product E also showed approximately twice as much MEK (by percentage) in the floor sweep as in the main inlet. A higher percentage of MEK is expected in the floor sweep gas because MEK, having a higher vapor pressure, would evaporate more rapidly at the coating station than toluene.

Table 5-9 shows the percentages of each species contained in the five products analyzed by gas chromatography. Products A and B are approximately 50 percent MEK and 50 percent toluene, Product E is 25 percent MEK and 75 percent toluene and Product F is 100 percent MEK. Product D contains

TABLE 5-8. RESULTS OF GAS CHROMATOGRAPHIC ANALYSES OF INLET, OUTLET AND INLET FLOOR SWEEP STREAMS FROM PLANT C-6. (Concentrations are given in ppmvC quantitated against propane.)

Date	Location	C_1	C_2-C_3	C_4	MEK C_5	C_6	Toluene C_7+	THC	Product	Catalyst Inlet Temp. °C (°F)	Catalyst Outlet Temp. °C (°F)
2/25/83	Inlet	45.4	ND	ND	6640	ND	ND	6690	F	285 (545)	460 (860)
	Outlet*	22	ND	ND	350	ND	5	380			
2/28/83	Inlet	17.8±6.8	ND	ND	3370±159	ND	3970±98	7350±247	B	285 (545)	416 (780)
	Floor-sweep	ND	ND	ND	1370	ND	629	2000			
2/28-3/1/83	Inlet	17.6±5.2	ND	ND	3100±302	ND	4290±664	7410±434	B	277 (530)	418 (785)
	Floor-sweep	ND	ND	ND	1260	ND	553	1810			
3/1/83	Outlet	17.7±5.6	ND	ND	75.7±13.4	ND	174±5	267±16	A	285 (545)	443 (830)
	Inlet	14.1	ND	ND	2770	ND	5030	7810			
3/2/83	Inlet	ND	ND	ND	3830±91	ND	4600±50	8430±115	B	338 (640)	474 (885)
3/2/83	Outlet	13.9±1.1	ND	ND	86.4±08	ND	97.6±4.6	198±6	B	341 (645)	457 (855)
3/3/83	Inlet	13.4	ND	210	1660	36	1980	3900	D	254 (490)	341 (645)
3/3/83	Inlet	16.3±0.9	ND	243±36	1680±113	94.5±16.3	1990±64	4010±28	D	288 (550)	374 (705)
	Outlet	15.9±2.9	ND	13.1±5.7	113±1	ND	65.7±3.0	208±7			
3/3/83	Inlet	15.1±5.6	ND	ND	2820±31	ND	3360±64	6200±40	B	341 (645)	443 (830)
	Outlet	14.1±1.1	ND	ND	76.8±32.2	ND	103±9	194±42			
	Floor-sweep	ND	ND	ND	1180	ND	533	1710			
3/4/83	Inlet	14.7±0.5	ND	ND	1770±350	ND	5480±477	7270±129	E	277 (530)	435 (815)
	Outlet	17.0±3.6	ND	ND	79.3±15.6	ND	161±4	257±12			
	Floor-sweep	17.8	ND	ND	836	ND	715	1570			

ND = Not detected. Detection limit = 9.0 ppmv-C.
*Sample analyzed at higher sensitivity. Detection limit = 0.9 ppmv-C.

TABLE 5-9. DESTRUCTION EFFICIENCIES OF MEK AND TOLUENE FOR DIFFERENT PRODUCTS AND TEMPERATURES - PLANT C-6

Date	Sample Location	Concentration ($ppmv-C_1$ quantitated against propane) MEK	Toluene	THC	Destruction Efficiency (%) MEK	Toluene	THC	Catalyst Temperature Inlet °C (°F)	Outlet °C (°F)	Product
3/1/83	Inlet	2570	4490	7070	97.1	96.1	96.3	285(545)	416(780)	A
	Outlet	75.7±13.4	174±5	267±16				285(545)	443(830)	
3/3/83	Inlet	2610±29	3000±57	5630±36	97.1	96.6	96.6	341(645)	443(830)	B
	Outlet	76.8±32.2	103±9	194±42						
3/3/83[ab]	Inlet	1560±155	1780±213	3630±403	92.8	96.3	94.3	288(550)	374(705)	D
	Outlet	113±1	65.7±3.0	208±7						
3/4/83	Inlet	1650±326	4880±424	6550±116	95.2	96.7	96.1	277(530)	435(815)	E
	Outlet	79.3±15.6	161±4	257±12						

[a]Other compounds besides MEK and toluene are present in this sample.

[b]Values for the floor sweep inlet in D were estimated by applying a main inlet/floor sweep ratio determined from other samples to each of components in the main inlet of D.

about 8 percent C_4 and C_6 hydrocarbons in addition to 43 percent MEK and 50 percent toluene.

Destruction efficiencies for MEK and toluene for products A, B, D and E are presented in Table 5-10. The table shows an average destruction efficiency of 96.4 percent for toluene. The toluene destruction efficiency is relatively constant for toluene inlet concentrations ranging from 1780 to 4880 ppmv-C and catalyst outlet temperatures ranging from 374°C (705°F) to 443°C (830°F). Average destruction efficiencies for MEK vary from 92.8 percent with Product D to 97.1 percent with Products A and B. The lower MEK destruction efficiencies for Products D and E may be a result of lower MEK inlet concentrations, approximately 1600 ppmv compared to 2600 ppmv for Products A and B.

Comparison of the 95 percent confidence intervals for the MEK and toluene destruction efficiencies shows overlap in nearly all cases. No conclusions can be made regarding the ease of destruction of MEK compared to toluene based on the data in Table 5-10.

Destruction efficiencies of THC for Products A, B and E averaged 96.4 percent. There is very little variation in the destruction efficiencies for these 3 products. The average THC destruction efficiency for Product D is 94.3 percent. The lower efficiency for Product D is probably a result of the lower inlet THC concentration.

A comparison of Method 25A and Method 18 THC destruction efficiencies is given in Table 5-11. While the Method 18 destruction efficiencies are slightly lower in all cases, the two test methods are in quite good agreement.

TABLE 5-10. DESTRUCTION EFFICIENCIES OF MEK AND TOLUENE FOR DIFFERENT PRODUCTS AND TEMPERATURES - PLANT C-6

Date	Sample Location	Method 18 Concentrations (ppmv-C_1 quantitated against propane) MEK	Toluene	THC	Destruction Efficiency, %[a] (Approximate 95% C.I.) MEK	Toluene	THC	Catalyst Temperature Inlet °C (°F)	Outlet °C (°F)	Product
3/1/83	Inlet	2570	4490	7070	97.1	96.1	96.3	285(545)	416(780)	A
	Outlet	75.7±13.4	174±5	267±16	(95.7, 98.0)	(95.0, 96.8)	(95.8, 96.7)	285(545)	443(830)	
3/3/83	Inlet	2610±29	3000±57	5630±36	97.1	96.6	96.6	341(645)	443(830)	B
	Outlet	76.8±32.2	103±9	194±42	(95.7, 98.5)	(96.2, 97.0)	(95.8, 97.4)			
3/3/83[bc]	Inlet	1560±155	1780±213	3630±403	92.8	96.3	94.3	288(550)	374(705)	D
	Outlet	113±1	65.7±3.0	208±7	(90.6, 94.2)	(94.5, 97.4)	(91.9, 95.8)			
3/4/83	Inlet	1650±326	4880±424	6550±116	95.2	96.7	96.1	277(530)	435(815)	E
	Outlet	79.3±15.6	161±4	257±12	(92.9, 96.7)	(96.3, 97.1)	(95.9, 96.3)			

[a] C.I. = confidence interval based on measurement variability.

Destruction Efficiency $= \frac{Min - Mout}{Min} \times 100\%$, where

$$M = \text{THC Mass Rate} = \frac{(V) \text{ moles C}}{10^6 \text{ moles gas}} \times \frac{12gC}{\text{mole C}} \times \frac{\text{mole gas}}{0.024 \text{ m}^3 \text{ gas}} \times \frac{(Q) \text{ m}^3 \text{ gas}}{\text{sec}}$$

V = species concentration (inlet or outlet), ppmv

Q = gas flowrate (inlet or outlet), Nm^3/sec

[b] Other compounds besides MEK and toluene are present in this sample.

[c] Values for the floor sweep inlet in D were estimated by applying a main inlet/floor sweep ratio determined from other samples to each of components in the main inlet of D.

TABLE 5-11. COMPARISON OF METHOD 18 AND METHOD 25A THC DESTRUCTION EFFICIENCIES

Date	Product	Catalyst Temperature Inlet/Outlet °C	(°F)	Method 18 THC Destruction Efficiency[a]	Method 25A Destruction Efficiency[b]
3/1/83	A	285/443	(545/830)	96.3	97.5
3/3/83	B	341/443	(645/830)	96.6	97.0
3/3/83	D	288/374	(550/705)	94.3	95.9
3/4/83	E	277/435	(530/815)	96.1	97.3

[a] From Table 5-9.
[b] From Table 5-3.

SECTION 5 REFERENCES

1. Lewis, D. L. and J. I. Steinmetz. Performance of Catalytic Incinerators at Industrial Sites: Quality Assurance Report. (Prepared for U. S. Environmental Protection Agency, Research Triangle Park, North Carolina) EPA Contract No. 68-02-3171, Task 50.

2. MSA Research Corporation. "Package Sorption Device System Study." U.S. Environmental Protection Agency. EPA-R2-73-202. April 1973.

3. Conklin, J.H., D.M. Sowards and J.H. Kroehling. E.I. duPont de Nemours & Co., Inc. "Industrial Exhaust Control." Reprinted from Kirk-Othmer: Encyclopedia of Chemical Technology, Volume 9, Third Edition. John Wiley & Sons, Inc. 1980.

APPENDIX A

METHOD 25A SAMPLING DATA

Method 25A sampling data are presented in this appendix. Each section of the appendix contains different data sampling locations as follows:

Section A.1 - Incinerator Main Inlet
Section A.2 - Incinerator Floor Sweep Inlet
Section A.3 - Incinerator Outlet

Breaks in the data are due to (1) calibration of the Byron analyzers, (2) prolonged shutdowns of the manufacturing process, or (3) instrument malfunctions.

The data tabulated in the following sections are expressed in ppmv as carbon (C_1). Data given at one-minute intervals were collected with the Byron 401 in the total hydrocarbon (THC) mode. Data given at three minute intervals were collected with the Byron 301 in the methane (CH_4) and nonmethane hydrocarbon (NMHC) mode. Data given at twelve-minute intervals were collected with the Byron 401 in the full-scan mode.

Overranges (OVRNGE) occurred when the concentrations exceeded the full scale of the analyzer. An overrange by the Byron 401 in the THC mode or the Byron 301 in the CH_4 mode caused all analyzers and modes to record an overrange.

One format is used in the data listings. The first column gives the time at which the sample was taken for the concentration given in column two of that row. Columns two through eleven contain from one to ten consecutive concentrations beginning at the time given in column one of that row. The time interval between successive concentration values depends on the analyzer and mode used in sampling.

SECTION A.1

MAIN INLET CONCENTRATIONS

CATALYTIC INCINERATOR PROGRAM PLANT NO 6 ATTN=100 MULT=1.011
CH4 CONCENTRATIONS AS C1 IN INLET (MAIN) STARTING AT 02/24 21;05

21;05	15	14	15	15	14	15	12	13	14	13
21;35	13	13	14	14	13					

AVERAGE CONC = 13.85 PPM AS C1 FOR 45 MINUTES

CATALYTIC INCINERATOR PROGRAM PLANT NO 6 ATTN=100 MULT=1.011
CH4 CONCENTRATIONS AS C1 IN INLET (MAIN) STARTING AT 02/25 02;53

02;53	21	19	17	18	17	15	15	17	16	14
03;23	19	29	25	18	13	48	52	15	13	25
03;53	13	57	18							

AVERAGE CONC = 22.42 PPM AS C1 FOR 69 MINUTES

06;32	23	20	18	15	15	15	15	17	60	19
07;02	61	27	14	14	15	17	23	18	47	57
07;32	15	33								

AVERAGE CONC = 25.33 PPM AS C1 FOR 66 MINUTES

08;47	13	63	19	21	21	20	21	20	21	27
09;17	31	14	20	23	15	59	24	27	29	30
09;47	46	37	35	42	30					

AVERAGE CONC = 28.30 PPM AS C1 FOR 75 MINUTES

10;41	18	15	29	32	19	19	19	20	42	56
11;11	64	53	19	48	19	74	18	56	16	16
11;44	53									

AVERAGE CONC = 33.58 PPM AS C1 FOR 63 MINUTES

17;05	25	17	17	15	15	15	14	15	15	13
17;35	13	13	14	12	13	15	14	16	15	25
18;05	13	59								

AVERAGE CONC = 17.45 PPM AS C1 FOR 66 MINUTES

CATALYTIC INCINERATOR PROGRAM PLANT NO 6 ATTN=100 MULT=1,011
CH4 CONCENTRATIONS AS C1 IN INLET (MAIN) STARTING AT 02/25 20;56

20;56	24	17	21	16	17	34	18	16	15	20
21;26	15	13	15	17						

AVERAGE CONC = 18.64 PPM AS C1 FOR 42 MINUTES

CATALYTIC INCINERATOR PROGRAM PLANT NO 6 ATTN=100 MULT=.9891
CH4 CONCENTRATIONS AS C1 IN INLET (MAIN) STARTING AT 02/28 07;27

07;27	36	63	52	18	19	21	18	62	58	61
07;57	59	55	54	25	20	19				

AVERAGE CONC = 39.87 PPM AS C1 FOR 48 MINUTES

14;08	12	11	10	10	11	10	9.7	9.7	11	11
14;38	12	9.7	11	12	11	9.7	12	9.7	10	11
15;08	10	11								

AVERAGE CONC = 10.60 PPM AS C1 FOR 66 MINUTES

15;41	22	28	11	12	12	10	11	11	10	10
16;29	10	11	11	11	11	10	11	10	10	11
16;59	11	10	11	10						

AVERAGE CONC = 12.06 PPM AS C1 FOR 72 MINUTES

19;22	11	10	11	10	11	12	11	11	10	10
19;58	12	11	11	11	10	11	12	9.7	11	12
20;28	12	11	9.7	10	11	12	12	11	12	12
20;58	13									

AVERAGE CONC = 11.19 PPM AS C1 FOR 93 MINUTES

21;49	12	12	12	12	12	11

AVERAGE CONC = 11.89 PPM AS C1 FOR 18 MINUTES

CATALYTIC INCINERATOR PROGRAM PLANT NO 6 ATTN=100 MULT=.9891
CH4 CONCENTRATIONS AS C1 IN INLET (MAIN) STARTING AT 03/01 14;00

14;00	9.7	8.53	9.7	9.7	9.7	9.31	8.53	9.31	7.76	8.53
14;30	9.7	8.92	9.7	8.53	8.53	9.31	7.76	8.92	9.31	8.14
15;00	8.14									

AVERAGE CONC = 8.938 PPM AS C1 FOR 63 MINUTES

17;12	9.7	12	18	8.53	7.37	7.76	7.37	8.14	8.53	8.14
17;42	7.76	8.14	7.37	8.14	8.14	8.14	8.14	7.76	7.76	23
18;12	8.14	6.98	7.76	8.14	6.98					

AVERAGE CONC = 9.121 PPM AS C1 FOR 75 MINUTES

21;06	9.31	24	8.14	7.76

AVERAGE CONC = 12.21 PPM AS C1 FOR 12 MINUTES

22;09	19	8.53	8.14	8.92	8.53	8.14	8.14	7.76	7.76	8.92
22;39	34	8.14	7.37	8.14	7.37	8.14	7.76	7.76	8.53	7.37
23;09	8.14	12	8.53	15	8.92	9.31	8.92	8.14	8.53	8.14

AVERAGE CONC = 9.824 PPM AS C1 FOR 90 MINUTES

00;33	9.7	9.7	10	10	11	9.7	9.7	10	8.92	11
01;03	12	10	20	10	9.7	9.7	9.7	9.7	10	9.7
01;33	11	11	13	13	12	14	12	12	13	13
02;03	12									

AVERAGE CONC = 11.23 PPM AS C1 FOR 93 MINUTES

CATALYTIC INCINERATOR PROGRAM PLANT NO 6 ATTN=100 MULT=.9891
CH4 CONCENTRATIONS AS C1 IN INLET (MAIN) STARTING AT 03/02 00;33

00;33	9.7	9.7	10	10	11	9.7	9.7	10	8.92	11
01;03	12	10	20	10	9.7	9.7	9.7	9.7	10	9.7
01;33	11	11	13	13	12	14	12	12	13	13
02;03	12									

AVERAGE CONC = 11.23 PPM AS C1 FOR 93 MINUTES

CATALYTIC INCINERATOR PROGRAM PLANT NO 6 ATTN=100 MULT=.9891
CH4 CONCENTRATIONS AS C1 IN INLET (MAIN) STARTING AT 03/02 04;39

04;39	14	13	14	13	12	11	12	11	11	11
05;09	11	11	11	11	11	10	10	9.7	9.7	9.7
05;39	10	9.7	8.92	10	10	10	9.7	10	10	11
06;09	10	9.7	9.31	9.7	25	10	9.7	9.7	9.7	16
06;39	10	9.7								

AVERAGE CONC = 11.09 PPM AS C1 FOR 126 MINUTES

07;15	10	12	11	11	12	11	11	11	11	12
07;45	48	13	13	13	14	13	14	26	16	41
08;15	12	12	10	10	11	7.37	12	16	21	12
08;45	18	15	9.7	29						

AVERAGE CONC = 15.26 PPM AS C1 FOR 102 MINUTES

09;39	12	12	11	11	9.31	11	9.31	11	10	9.7
10;09	10	9.7	11	9.7	8.92	9.31	10	8.92	9.7	8.92
10;39	8.92	9.31	8.53	9.7	8.53	10	9.31	8.14	9.7	8.92
11;09	9.7	9.31	7.76							

AVERAGE CONC = 9.705 PPM AS C1 FOR 99 MINUTES

12;36	11	10	9.7	8.53	8.92	8.53	9.7	9.31	8.53	8.92
13;06	9.31	8.53	8.92	8.14	9.31	8.14	8.92	8.53	9.31	8.14
13;36	8.92	9.31	9.7	8.53	9.7	9.7	8.92	9.31	8.53	9.31

AVERAGE CONC = 9.074 PPM AS C1 FOR 90 MINUTES

19;38	16	14	14	15	14	14	15	15	14	15
20;08	12	12								

AVERAGE CONC = 14.05 PPM AS C1 FOR 36 MINUTES

20;53	19	16	16	15	14	12	11	12	11	12
21;23	15									

AVERAGE CONC = 13.95 PPM AS C1 FOR 33 MINUTES

CATALYTIC INCINERATOR PROGRAM PLANT NO 6 ATTN=100 MULT=1.003
CH4 CONCENTRATIONS AS C1 IN INLET (MAIN) STARTING AT 03/03 09;32

09;32	9.05	8.26	8.66	7.87	8.26	8.26	9.05	10	10	9.84

AVERAGE CONC = 8.970 PPM AS C1 FOR 30 MINUTES

10;05	9.05	8.66	8.66	7.87	8.26	8.66	8.26	8.26	8.66	9.84
10;35	9.44	8.66	9.44	8.66	9.05	9.05	8.66	9.44	9.84	9.84
11;05	9.05									

AVERAGE CONC = 8.918 PPM AS C1 FOR 63 MINUTES

11;47	9.84	9.44	9.44	8.66	7.48	8.26	8.26	8.66	8.66	9.05
12;17	9.05									

AVERAGE CONC = 8.799 PPM AS C1 FOR 33 MINUTES

CATALYTIC INCINERATOR PROGRAM PLANT NO 6 ATTN=100 MULT=1.004
CH4 CONCENTRATIONS AS C1 IN INLET (MAIN) STARTING AT 03/03 15;59

15;59	10	9.45	9.84	9.84	9.84	9.45	9.05	11	9.84	9.84
16;29	9.45	9.05	9.05	11	11	11	13	13	13	15
16;59	14	15	15	14	13					

AVERAGE CONC = 11.34 PPM AS C1 FOR 75 MINUTES

20;18	13	11	12	14	13	12	13	0	11	12
20;48	12	11	11	9.84	6.3	6.69	12	12	11	12
21;18	12	13	0	12	13	11	12	12	13	14
21;48	15	15	12	13	11	11	12	11	12	13
22;18	12									

AVERAGE CONC = 11.24 PPM AS C1 FOR 123 MINUTES

23;45	12	10	12	12	11	11	11	10	12	11

AVERAGE CONC = 11.21 PPM AS C1 FOR 30 MINUTES

CATALYTIC INCINERATOR PROGRAM PLANT NO 6 ATTN=100 MULT=1.004
CH4 CONCENTRATIONS AS C1 IN INLET (MAIN) STARTING AT 03/04 00;54

00;54	9.84	11	10	10	9.05	11	11	11	10	12
01;24	11	11	11	11	13	10	13	11	13	11
01;54	14	12								

AVERAGE CONC = 11.26 PPM AS C1 FOR 66 MINUTES

02;45	14	13	12	13	13	14	13	13	13	12
03;15	13	13	12	11	11	13	12	11	12	12
03;45	12	11	11	10	11	12	12	11	11	11
04;15	11	10	11	11	11	12	10	11	11	11
04;45	12	11	11	11	11	11	11	13		

AVERAGE CONC = 11.72 PPM AS C1 FOR 144 MINUTES

05;42	11	11	13	11	10	10	11	11	11	10
06;12	12	11	12	9.84	10	11	11	12	13	12
06;42	11	13	15	13	11	11	12	11	13	13
07;12	14	12	12	11	11	13	11	12	12	12
07;42	12	11	11	11	12	13				

AVERAGE CONC = 11.74 PPM AS C1 FOR 138 MINUTES

17;32	13	11	11	12	9.45	10	10

AVERAGE CONC = 11.07 PPM AS C1 FOR 21 MINUTES

17;56	11	11	11	11	9.84	11	9.45	9.84	10	10
18;26	11	9.84	11	9.84	9.05	9.45	10	12	13	14
18;56	12	12	12	12						

AVERAGE CONC = 10.90 PPM AS C1 FOR 72 MINUTES

19;57	13	13	13	13	13	13	13	11	13	13

AVERAGE CONC = 12.63 PPM AS C1 FOR 30 MINUTES

21;30	15	12	11	9.84	10	13	11	9.84	11	11
22;00	12	12	11	12						

AVERAGE CONC = 11.52 PPM AS C1 FOR 42 MINUTES

CATALYTIC INCINERATOR PROGRAM PLANT NO 6 ATTN=4000 MULT=122.8
NMHC CONCENTRATIONS AS C1 IN INLET (MAIN) STARTING AT 02/24 21;05

21;05	9682	9682	9922	9489	9200	9200	9104	9296	9778	9537
21;35	9682	10019	8911	8911	8381					

AVERAGE CONC = 9386. PPM AS C1 FOR 45 MINUTES

CATALYTIC INCINERATOR PROGRAM PLANT NO 6 ATTN=4000 MULT=122.8
NMHC CONCENTRATIONS AS C1 IN INLET (MAIN) STARTING AT 02/25 02;53

02;53	8236	8622	8863	8622	8959	8911	8911	8959	8959	9104
03;23	9393	9248	9633	9537	9682	9922	9633	9874	9537	9826
03;53	9778	9874	9778							

AVERAGE CONC = 9298. PPM AS C1 FOR 69 MINUTES

06;32	9104	9152	9344	9200	9104	9296	9200	9055	9104	8959
07;02	9200	9682	9778	10067	9922	9922	9826	9874	9922	9826
07;32	9730	10019								

AVERAGE CONC = 9513 PPM AS C1 FOR 66 MINUTES

08;47	8188	9778	9585	9922	9730	9537	9682	9633	9730	9682
09;17	9778	9585	9682	9682	9826	9730	9633	9922	9826	9441
09;47	9778	9826	9922	9826	9682					

AVERAGE CONC = 9664. PPM AS C1 FOR 75 MINUTES

10;41	10115	10308	10356	10260	10211	10260	10260	10211	10308	10404
11;11	10260	10260	10308	10163	10308	11368	10260	10452	10500	10308
11;44	9971									

AVERAGE CONC = 10326 PPM AS C1 FOR 63 MINUTES

17;05	7947	7514	7947	7707	7610	7466	7610	7369	7369	7562
17;35	7418	7562	8815	8815	8381	8188	8574	8236	8333	8574
18;05	8670	8477								

AVERAGE CONC = 8006. PPM AS C1 FOR 66 MINUTES

CATALYTIC INCINERATOR PROGRAM PLANT NO 6 ATIN=4000 MULT=122.8
NMHC CONCENTRATIONS AS C1 IN INLET (MAIN) STARTING AT 02/25 20;56

20;56	8718	8815	9055	9248	8959	9007	8622	8477	8429	8911
21;26	8766	8670	8959	8718						

AVERAGE CONC = 8811 PPM AS C1 FOR 42 MINUTES

CATALYTIC INCINERATOR PROGRAM PLANT NO 6 ATTN=10000 MULT=295.5
NMHC CONCENTRATIONS AS C1 IN INLET (MAIN) STARTING AT 02/28 07;27

07;27	11589	11125	11589	11473	11009	11357	11241	11241	11473	10893
07;57	11125	11125	11125	11009	11589	11009				

AVERAGE CONC = 11248 PPM AS C1 FOR 48 MINUTES

14;08	10777	10546	10893	11009	10198	11009	10893	10893	11009	11009
14;38	11125	10893	11125	11009	10777	11125	11241	10893		

AVERAGE CONC = 10912 PPM AS C1 FOR 54 MINUTES

15;05	10777	11241	10777

AVERAGE CONC = 10931 PPM AS C1 FOR 9 MINUTES

15;41	10893	11125	10662	10662	10893	11125	10662	11009	11009	10546
16;29	10777	10777	11009	10430	10893	10777	10893	11125	10430	10546
16;59	10777	11009	11241	10662						

AVERAGE CONC = 10830 PPM AS C1 FOR 72 MINUTES

```
CATALYTIC INCINERATOR PROGRAM          PLANT NO 6          ATTN=20000 MULT=591.1
NMHC CONCENTRATIONS AS C1 IN  INLET (MAIN)  STARTING AT 02/28 19;22
-------------------------------------------------------------------------------

19;22     10430  10430  11357  11357  11125  10662  11125

AVERAGE CONC = 10926 PPM AS C1 FOR  21 MINUTES
-------------------------------------------------------------------------------


CATALYTIC INCINERATOR PROGRAM          PLANT NO 6          ATTN=10000 MULT=295.5
NMHC CONCENTRATIONS AS C1 IN  INLET (MAIN)  STARTING AT 02/28 19;49
-------------------------------------------------------------------------------

19;49     11009  10893  11241  11241  11125  11009  11009  10893  11125  10777
20;19     11241  10893  11009  11125  10893  10777  10777  10893  10662  10893
20;49     10777  11009  10662  11357

AVERAGE CONC = 10970 PPM AS C1 FOR  72 MINUTES
-------------------------------------------------------------------------------


21;49      9619   9503   9387  10777  11125  10893

AVERAGE CONC = 10217 PPM AS C1 FOR  18 MINUTES
-------------------------------------------------------------------------------


CATALYTIC INCINERATOR PROGRAM          PLANT NO 6          ATTN=10000 MULT=293.2
NMHC CONCENTRATIONS AS C1 IN  INLET (MAIN)  STARTING AT 03/01 14;00
-------------------------------------------------------------------------------

14;00     11728  11498  11268  11268  11498  11038  11268  11268  11613  11498
14;30     11728  11613  11728  11843  11383  11728  11383  11498  11498  11498
15;00     11958

AVERAGE CONC = 11514 PPM AS C1 FOR  63 MINUTES
-------------------------------------------------------------------------------


17;12     11728  13338  13338  13338  12763  12878  12533  12763  12763  12878
17;42     12993  12763  12763  12648  12763  12648  12303  13223  13338  13453
18;12     13108  12878  13108  12993  12303

AVERAGE CONC = 12864 PPM AS C1 FOR  75 MINUTES
-------------------------------------------------------------------------------


21;06     12418  12418  12763  12418

AVERAGE CONC = 12504 PPM AS C1 FOR  12 MINUTES
-------------------------------------------------------------------------------
```

CATALYTIC INCINERATOR PROGRAM PLANT NO 6 ATTN=10000 MULT=293.2
NMHC CONCENTRATIONS AS C1 IN INLET (MAIN) STARTING AT 03/01 22;09

22;09	10463	10578	10348	10693	10693	12073	12418	12648	12763	12648
22;39	12993	12878	13108	12648	12648	12648	12763	12763	12418	12188
23;09	12533	12418	12533	12763	12533	12763	12878	12648	12878	12763

AVERAGE CONC = 12303 PPM AS C1 FOR 90 MINUTES

CATALYTIC INCINERATOR PROGRAM PLANT NO 6 ATTN=10000 MULT=293.2
NMHC CONCENTRATIONS AS C1 IN INLET (MAIN) STARTING AT 03/02 00;33

00;33	11728	12073	12878	12878	12993	12533	12763	12763	12303	12763
01;03	12533	12303	12303	12418	12533	12648	12188	12533	12533	12648
01;33	12878	12418	12303	12878	12303	12648	12188	12418	12303	12763
02;03	12188									

AVERAGE CONC = 12503 PPM AS C1 FOR 93 MINUTES

04;39	9888	10348	10233	9888	10233	10003	10118	9888	10118	9773
05;09	10003	10233	10578	9773	10003	10463	10003	10003	10463	10578
05;39	10003	10003	10118	10118	10233	9888	10348	10348	10463	10578
06;09	10118	10578	10003	10233	10463	10578	10233	10463	10003	10118
06;39	10233	10003								

AVERAGE CONC = 10183 PPM AS C1 FOR 126 MINUTES

07;15	10348	10003	10118	10003	10348	10003	10348	11728	12073	11383
07;45	11728	11613	11958	11843	11728	11498	11843	11728	11498	11843
08;15	12073	11268	11613	11383	11728	1034	11613	11843	11728	12533
08;45	13108	12188	12533	12533						

AVERAGE CONC = 11200 PPM AS C1 FOR 102 MINUTES

09;39	11383	12418	12073	12648	12878	12648	12418	12303	12418	12303
10;09	12188	12648	12533	12533	12533	12763	12648	12763	12533	12073
10;39	12073	12188	11958	11958	12188	12073	12303	12533	12418	12303
11;09	12533	12188	12418							

AVERAGE CONC = 12358 PPM AS C1 FOR 99 MINUTES

12;36	8623	9888	9428	10463	10118	9773

AVERAGE CONC = 9715. PPM AS C1 FOR 18 MINUTES

CATALYTIC INCINERATOR PROGRAM PLANT NO 6 ATTN=10000 MULT=293.2
NMHC CONCENTRATIONS AS C1 IN INLET (MAIN) STARTING AT 03/02 12;57

12;57	10348	10118	9888	11613	10348	10233	10118	10463	10118	10003
13;27	9888	10003	9888	10003	10003	10003	10118	10348	10463•	9888
13;57	10463	10463	10463							

AVERAGE CONC = 10228 PPM AS C1 FOR 69 MINUTES

19;38	9125	9125	8888	9125	8770	9007	8770	9481	8177	9244
20;08	8414	8651								

AVERAGE CONC = 8898. PPM AS C1 FOR 36 MINUTES

20;53	7940	9244	9600	8888	8770	8770	3414	8651	8177	8414
21;23	8888									

AVERAGE CONC = 8705. PPM AS C1 FOR 33 MINUTES

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CATALYTIC INCINERATOR PROGRAM          PLANT NO 6          ATTN=10000 MULT=302.1
NMHC CONCENTRATIONS AS C1 IN  INLET (MAIN)  STARTING AT 03/03 09;32
-------------------------------------------------------------------------------

09;32      6752   7345   6989   6871   6989   6752   6871   6989   6397   6515

AVERAGE CONC = 6847 PPM AS C1 FOR  30 MINUTES
-------------------------------------------------------------------------------

10;05      6397   6278   6160   6515   5923   6278   6515   6278   6397   6397
10;35      6042   6397   6278   6160   6160   6515   6515   6752   6160   6397
11;05      5805

AVERAGE CONC = 6300. PPM AS C1 FOR  63 MINUTES
-------------------------------------------------------------------------------

11;47      5805   6515   5923   6278   6042   6160   6278   6634   6397   6042
12;17      6278

AVERAGE CONC = 6213. PPM AS C1 FOR  33 MINUTES
-------------------------------------------------------------------------------

CATALYTIC INCINERATOR PROGRAM          PLANT NO 6          ATTN=4000 MULT=120.8
NMHC CONCENTRATIONS AS C1 IN  INLET (MAIN)  STARTING AT 03/03 15;59
-------------------------------------------------------------------------------

15;59      6636   6636   6588   6494   6494   6683   6588   6683   6494   6636
16;29      6446   6399   6636   6446   6636   6351   6446   6588   6588   6446
16;59      6683   6541   6494   6304   6351

AVERAGE CONC = 6531. PPM AS C1 FOR  75 MINUTES
-------------------------------------------------------------------------------

CATALYTIC INCINERATOR PROGRAM          PLANT NO 6          ATTN=4000 MULT=118.1
NMHC CONCENTRATIONS AS C1 IN  INLET (MAIN)  STARTING AT 03/03 20;18
-------------------------------------------------------------------------------

20;18      7039   7270   8335   9123   9493   9262   9215   9308   9262   9354
20;48      9447   9401   9308   5001     93    185   7456   9632   9308   9447
21;18      9586   9540   9540   9401   9401   9540   9401   9493   9540   9540
21;48      9401   9493   9632   9354   9493   9540   9447   9308   9401   9354
22;18      9447

AVERAGE CONC = 8677. PPM AS C1 FOR  123 MINUTES
-------------------------------------------------------------------------------

23;45      9401   9262   9076   9030   9401   9864   9030   8938   9123   9076

AVERAGE CONC = 9220. PPM AS C1 FOR  30 MINUTES
-------------------------------------------------------------------------------
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CATALYTIC INCINERATOR PROGRAM          PLANT NO 6          ATTN=4000 MUL1=118.1
NMHC CONCENTRATIONS AS C1 IN  INLET (MAIN)  STARTING AT 03/04 00;54
-------------------------------------------------------------------------------

00;54     10049   9679   9586   9632   9354   9493   9540   9725   9679   9679
01;24      9354   9447   9679   9586   9679   9632   9401   9447   9586   9447
01;54      9586   9586

AVERAGE CONC = 9583. PPM AS C1 FOR  66 MINUTES
-------------------------------------------------------------------------------

02;45      9354   9771   9540   9540   9725   9493   9447   9771   9540   9493
03;15      9447   9679   9447   9679   9679   9354   9771   9540   9540   9632
03;45      9632   9447   9586   9447   9401   9354   9447   9493   9447   9354
04;15      9354   9354   9632   9354   9262   9401   9493   9354   9632   9447
04;45      9123   9169   9076   9123   9169   9308   9308   9262

AVERAGE CONC = 9455. PPM AS C1 FOR  144 MINUTES
-------------------------------------------------------------------------------

05;42      9586   9262   9401   9123   9169   8891   9262   9169   9215   9262
06;12      9401   9262   9123   9123   9123   9354   9401   9262   9262   9215
06;42      9215   9262   9169   9215   9354   9354   9169   9215   9169   9354
07;12      9169   9123   8984   9123   9123   9076   9123   8938   9076   9354
07;42      9123   9169   9123   9123   8938   9308

AVERAGE CONC = 9200. PPM AS C1 FOR  138 MINUTES
-------------------------------------------------------------------------------

17;32     10049 OVRNGE OVRNGE OVRNGE  11485 OVRNGE OVRNGE

AVERAGE CONC = 10767 PPM AS C1 FOR  21 MINUTES    (5 OVERANGED POINTS);
-------------------------------------------------------------------------------

CATALYTIC INCINERATOR PROGRAM          PLANT NO 6          ATTN=10000 MUL1=295.2
NMHC CONCENTRATIONS AS C1 IN  INLET (MAIN)  STARTING AT 03/04 17;56
-------------------------------------------------------------------------------

17;56     11346  10998  11461  11693  10883  11114  11230  10767  10998  10883
18;26     10651  10998  11230  10883  10767  10535  10767  11230  11114  10651
18;56     10998  11114  10883  10998

AVERAGE CONC = 11008 PPM AS C1 FOR  72 MINUTES
-------------------------------------------------------------------------------

19;57     11461  11577  11346  11693  11809  11693  11577  11346  11577  11693

AVERAGE CONC = 11577 PPM AS C1 FOR  30 MINUTES
-------------------------------------------------------------------------------
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CATALYTIC INCINERATOR PROGRAM PLANT NO 6 ATTN=10000 MULT=295.2
NMHC CONCENTRATIONS AS C1 IN INLET (MAIN) STARTING AT 03/04 21;30

21;30	9725	9956	10072	9493	11461	11809	11577	11461	11346	11809
22;00	11693	11346	11809	11693						

AVERAGE CONC = 11089 PPM AS C1 FOR 42 MINUTES

SECTION A.2

FLOOR SWEEP INLET CONCENTRATIONS

CATALYTIC INCINERATOR PROGRAM PLANT NO 6 ATTN=100 MULT=.9891
CH4 CONCENTRATIONS AS C1 IN FLOOR SWEEP STARTING AT 02/28 17;35

17;35 7.37 6.98

AVERAGE CONC = 7.174 PPM AS C1 FOR 6 MINUTES

18;13	12	7.76	6.98	8.53	7.76	6.98	10	8.53	8.53	6.21
18;43	6.59	7.37	8.14	7.37	7.37	8.14	7.76	6.98	7.37	6.59
19;13	9.31									

AVERAGE CONC = 7.940 PPM AS C1 FOR 63 MINUTES

CATALYTIC INCINERATOR PROGRAM PLANT NO 6 ATTN=100 MULT=.9881
CH4 CONCENTRATIONS AS C1 IN FLOOR SWEEP STARTING AT 03/01 19;56

19;56	6.2	6.2	5.81	5.81	5.81	5.42	5.42	5.42	5.81	5.42
20;26	5.42	5.42	5.42	5.42	5.04					

AVERAGE CONC = 5.604 PPM AS C1 FOR 45 MINUTES

CATALYTIC INCINERATOR PROGRAM PLANT NO 6 ATTN=100 MULT=1.004
CH4 CONCENTRATIONS AS C1 IN FLOOR SWEEP STARTING AT 03/03 17;18

17;18 20 19 17

AVERAGE CONC = 18.5 PPM AS C1 FOR 9 MINUTES

22;25	13	11	9.05	12	13	13	12	13	11	12
22;55	18	14	17	13	15	11	9.84	15	9.05	8.66
23;25	7.48	11	12	12						

AVERAGE CONC = 12.23 PPM AS C1 FOR 72 MINUTES

CATALYTIC INCINERATOR PROGRAM PLANT NO 6 ATTN=100 MULT=1.004
CH4 CONCENTRATIONS AS C1 IN FLOOR SWEEP STARTING AT 03/04 19;12

19;12	8.66	9.05	10	9.84	13	10	9.45	9.05	9.05	9.84
19;42	14	11	11							

AVERAGE CONC = 10.35 PPM AS C1 FOR 39 MINUTES

CATALYTIC INCINERATOR PROGRAM PLANT NO 6 ATTN=2000 MULT=59.11
NMHC CONCENTRATIONS AS C1 IN FLOOR SWEEP STARTING AT 02/28 17;35

17;35 2271 2480

AVERAGE CONC = 2375. PPM AS C1 FOR 6 MINUTES

CATALYTIC INCINERATOR PROGRAM PLANT NO 6 ATTN=1000 MULT=29.55
NMHC CONCENTRATIONS AS C1 IN FLOOR SWEEP STARTING AT 02/28 18;13

18;13	2804	2781	2874	2688	2572	2711	2758	2132	2248	2283
18;43	2549	2364	2862	2885	2839	2758	2619	2468	2491	2456
19;13	2225									

AVERAGE CONC = 2588. PPM AS C1 FOR 63 MINUTES

CATALYTIC INCINERATOR PROGRAM PLANT NO 6 ATTN=10000 MULT=293.2
NMHC CONCENTRATIONS AS C1 IN FLOOR SWEEP STARTING AT 03/01 19;56

19;56 2644 2874 2299 2644

AVERAGE CONC = 2615. PPM AS C1 FOR 12 MINUTES

CATALYTIC INCINERATOR PROGRAM PLANT NO 6 ATTN=4000 MULT=117.3
NMHC CONCENTRATIONS AS C1 IN FLOOR SWEEP STARTING AT 03/01 20;08

20;08 2345

AVERAGE CONC = 2345 PPM AS C1 FOR 3 MINUTES

CATALYTIC INCINERATOR PROGRAM PLANT NO 6 ATTN=1000 MULT=29.32
NMHC CONCENTRATIONS AS C1 IN FLOOR SWEEP STARTING AT 03/01 20;11

20;11	2851	2575	2529	2483	2587	2529	2564	2472	2552	2610

AVERAGE CONC = 2575. PPM AS C1 FOR 30 MINUTES

CATALYTIC INCINERATOR PROGRAM PLANT NO 6 ATTN=4000 MULT=120.8
NMHC CONCENTRATIONS AS C1 IN FLOOR SWEEP STARTING AT 03/03 17;18

17;18 2512 2512 2275

AVERAGE CONC = 2433 PPM AS C1 FOR 9 MINUTES

CATALYTIC INCINERATOR PROGRAM PLANT NO 6 ATTN=2000 MULT=59.05
NMHC CONCENTRATIONS AS C1 IN FLOOR SWEEP STARTING AT 03/03 22;25

22;25	OVRNGE	OVRNGE	2686	2755	3010	3010	3612	3264	3102	2894
22;55	2709	3079	3125	3195	2639	2500	2778	2477	2755	2755
23;25	2639	2732	2894	2662						

AVERAGE CONC = 2876 PPM AS C1 FOR 72 MINUTES (2 OVERANGED POINTS);

CATALYTIC INCINERATOR PROGRAM PLANT NO 6 ATTN=1000 MULT=29.52
NMHC CONCENTRATIONS AS C1 IN FLOOR SWEEP STARTING AT 03/04 19;12

19;12	2269	2385	2315	2269	2292	2303	2327	2454	2408	2535
19;42	2431	2431	2292							

AVERAGE CONC = 2362. PPM AS C1 FOR 39 MINUTES

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SECTION A.3

OUTLET CONCENTRATIONS

CATALYTIC INCINERATOR PROGRAM PLANT NO 6 ATTN=500 MULT=3.903
THC CONCENTRATIONS AS C1 IN OUTLET STARTING AT 02/25 11;36

11;36	219	219	210	210	211	230	223	194

AVERAGE CONC = 214.4 PPM AS C1 FOR 8 MINUTES

17;02	188	205	202	210	211	210	205	210	208	202
17;12	211	194	202	197	205	196	202	196	202	191
17;22	210	191	191	204	202	196	191	197	191	197
17;32	191	191	197	184	194	200	200	202	191	205
17;42	188	191	191	197	205	191	194	185	208	188
17;52	191	216	308	200	219	191	182	197	205	191
18;02	194	194	194	200	269					

AVERAGE CONC = 201.0 PPM AS C1 FOR 65 MINUTES

20;53	202	191	208	202	191	204	191	321	191	196
21;03	202	191	188	196	191	191	205	191	194	188
21;13	240	204	185	191	182	188	188	191	197	199
21;23	219	191	200	197	185	231	191	191	184	196
21;33	191	196								

AVERAGE CONC = 199.4 PPM AS C1 FOR 42 MINUTES

CATALYTIC INCINERATOR PROGRAM PLANT NO 6 ATTN=500 MULT=4.409
THC CONCENTRATIONS AS C1 IN OUTLET STARTING AT 02/28 07;25

07;25	280	237	265	334	237	265	308	239	275	245
07;35	240	290	245	240	328	237	245	280	244	237
07;45	252	332	240	249	320	235	256	316	237	251
07;55	304	235	232	284	232	265	309	235	277	247
08;05	240	284	239	237	315	235	228			

AVERAGE CONC = 262.8 PPM AS C1 FOR 47 MINUTES

13;14	325	322	332	334	320	320	316	306	299	309
13;24	306	301	299	296	292	297	306	304	308	299
13;34	297	292	287	271	280	289	289	292	292	297
13;44	292	296	301	296	289	292	306	296	284	297
13;54	292	290	290	299	296	284	287	292	292	

AVERAGE CONC = 298.8 PPM AS C1 FOR 49 MINUTES

CATALYTIC INCINERATOR PROGRAM PLANT NO 6 ATTN=500 MULT=4.409
THC CONCENTRATIONS AS C1 IN OUTLET STARTING AT 02/28 14;06

14;06	296	296	285	287	296	292	289	284	301	292
14;16	289	289	304	296	284	289	301	292	284	289
14;26	285	289	289	297	287	289	297	292	290	297
14;36	296	296	287	292	287	289	290	290	290	292
14;46	292	289	297	289	296	290	296	289	292	287
14;56	287	289	284	289	287	297	296	292	297	290
15;06	287	290	292	290	292	284				

AVERAGE CONC = 291.0 PPM AS C1 FOR 66 MINUTES

15;39	316	309	316	339	322	309	308	301	299	289
15;49	280	290								

AVERAGE CONC = 306.5 PPM AS C1 FOR 12 MINUTES

17;13	287	292	289	287	289	285	289	285	284	292
17;23	289	296								

AVERAGE CONC = 288.5 PPM AS C1 FOR 12 MINUTES

17;33	280	285	292	280	287

AVERAGE CONC = 284.8 PPM AS C1 FOR 5 MINUTES

18;12	322	328	315	313	342	330	322	367	325	320
18;22	325	323	322	361	316	398	315	316	313	306
18;32	308	320	328	313	316	313	306	313	313	301
18;42	313	315	309	308	313	334	309	301	309	313
18;52	313	308	297	284	287	289	285	290	289	287
19;02	287	289	287	285	287	284	292	296	289	292
19;12	299	292	292	297	289					

AVERAGE CONC = 309.4 PPM AS C1 FOR 65 MINUTES

19;20	292	289	289	289	289	292	292	287	292	292
19;30	297	285	289	292	284	301	285	284	296	292
19;40	292									

AVERAGE CONC = 290.3 PPM AS C1 FOR 21 MINUTES

CATALYTIC INCINERATOR PROGRAM PLANT NO 6 ATTN=500 MULT=4.409
THC CONCENTRATIONS AS C1 IN OUTLET STARTING AT 02/28 19;47

19;47	292	287	287	292	285	289	292	292	287	285
19;57	287	297	287	285	297	292	289	287	292	287
20;07	296	287	285	280	287	287	292	296	292	292
20;17	289	287	296	284	289	280	285	299	289	292
20;27	289	297	289	292	296	289	292	292	284	297
20;37	292	287	292	296	280	292	289	290	296	292
20;47	289	296	292	299	285	297	289	292	292	296
20;57	287	292								

AVERAGE CONC = 290.2 PPM AS C1 FOR 72 MINUTES

21;47	244	232	280	297	297	273	297	296	299	316
21;57	306	309	301	301	299	297	299	297		

AVERAGE CONC = 291.1 PPM AS C1 FOR 18 MINUTES

CATALYTIC INCINERATOR PROGRAM PLANT NO 6 ATTN=500 MULT=4.452
THC CONCENTRATIONS AS C1 IN OUTLET STARTING AT 03/01 13;58

13;58	300	292	293	292	300	302	300	286	290	286
14;08	293	293	290	295	295	285	290	290	283	286
14;18	286	295	300	290	292	290	293	292	283	293
14;28	293	292	293	290	295	292	290	300	299	283
14;38	300	286	279	278	269	276	260	274	267	279
14;48	269	269	269	271	274	265	276	274	274	271
14;58	278	274	372							

AVERAGE CONC = 286.9 PPM AS C1 FOR 63 MINUTES

17;11	264	312	346	314	304	307	293	295	293	290
17;21	299	295	290	283	293	292	283	286	290	295
17;31	292	293	290	295	292	302	292	299	286	293
17;41	286	285	292	286	293	295	283	283	283	300
17;51	295	302	290	293	293	295	283	290	290	292
18;01	299	293	295	302	300	302	316	302	307	304
18;11	295	300	292	299	286	299	292	299	286	286
18;21	299	293	293	295						

AVERAGE CONC = 294.5 PPM AS C1 FOR 74 MINUTES

21;04	283	290	283	295	279	283	290	283	283	279
21;14	279									

AVERAGE CONC = 284.2 PPM AS C1 FOR 11 MINUTES

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CATALYTIC INCINERATOR PROGRAM PLANT NO 6 ATTN=500 MULT=4.452
THC CONCENTRATIONS AS C1 IN OUTLET STARTING AT 03/01 22;06

22;06	340	279	319	274	271	267	271	271	271	274
22;16	267	264	267	262	265	295	283	283	283	279
22;26	279	288	286	288	292	286	292	288	299	304
22;36	295	332	295	295	295	295	290	292	288	283
22;46	286	292	295	286	295	295	295	286	295	288
22;56	295	292	288	290	295	295	283	288	288	286
23;06	290	288	286	311	290	290	300	283	283	290
23;16	290	295	292	286	290	286	292	292	288	295
23;26	295	292	288	288	290	290	292	295	290	292
23;36	292									

AVERAGE CONC = 288.6 PPM AS C1 FOR 91 MINUTES

CATALYTIC INCINERATOR PROGRAM PLANT NO 6 ATTN=500 MULT=4.452
THC CONCENTRATIONS AS C1 IN OUTLET STARTING AT 03/02 00;31

00;31	288	311	312	309	295	316	307	299	299	300
00;41	299	304	300	304	299	290	299	292	300	288
00;51	292	292	295	299	299	295	283	295	292	292
01;01	295	286	292	283	290	292	300	292	288	283
01;11	290	295	299	299	295	292	283	283	283	292
01;21	295	290	295	292	292	283	292	286	288	283
01;31	292	290	290	290	295	286	286	283	286	295
01;41	288	286	292	295	295	304	292	292	283	283
01;51	292	288	299	299	299	292	292	290	304	304
02;01	290	295	299							

AVERAGE CONC = 293.3 PPM AS C1 FOR 93 MINUTES

04;38	274	292	292	290	292	290	286	292	286	283
04;48	279	283	276	276	283	279	279	292	283	283
04;58	274	279	279	286	279	274	272	274	283	272
05;08	279	279	283	276	279	288	283	276	279	276
05;18	286	279	288	279	276	276	279	283	283	274
05;28	283	283	279	283	272	274	283	276	272	274
05;38	279	279	276	279	281	271	274	274	271	272
05;48	279	283	279	279	276	276	272	271	279	276
05;58	276	276	272	283	274	279	283	276	274	279
06;08	267	274	276	276	267	272	279	349	272	283
06;18	279	295	279	325	279	272	276	276	279	279
06;28	276	276	286	276	271	292	295	283	347	279
06;38	279	274	271							

AVERAGE CONC = 280.4 PPM AS C1 FOR 123 MINUTES

CATALYTIC INCINERATOR PROGRAM PLANT NO 6 ATTN=500 MULT=4.452
THC CONCENTRATIONS AS C1 IN OUTLET STARTING AT 03/02 07;13

07;13	272	381	295	304	295	286	290	290	288	288
07;23	283	274	283	276	272	276	274	278	272	302
07;33	304	295	295	292	295	288	292	292	283	283
07;43	358	361	288	292	283	295	283	295	283	288
07;53	356	295	288	295	290	286	292	290	293	286
08;03	286	295	283	295	286	290	286	323	288	288
08;13	286	283	290	286	286	295	290	283	283	286
08;23	292	286	290	283	279	68	309	286	279	304
08;33	299	311	292	288	295	356	304	302	302	319
08;43	295	299	295	299	295	299	299	344	307	312

AVERAGE CONC = 292.6 PPM AS C1 FOR 100 MINUTES

09;33	241	283	292	283	283	260	271	274	265	267
09;43	253	255	255	260	255	253	251	253	248	248
09;53	251	253	246	248	241	250	243	248	248	241
10;03	246	248	250	248	246	246	248	248	251	250
10;13	241	248	241	248	251	248	246	243	248	244
10;23	253	246	250	241	250	243	239	248	244	246
10;33	250	246	250	250	244	248	239	248	248	251
10;43	239	250	241	250	237	250	239	246	246	250
10;53	248	248	251	241	251	239	253	246	250	250
11;03	253	253	244	246	248	248	246	248	241	253
11;13	246	250								

AVERAGE CONC = 249.8 PPM AS C1 FOR 102 MINUTES

12;32	218	218	232	211	227	230	218	223	218	232
12;42	227	227	211	216	215	211	215	209	222	211
12;52	223	211	222	216	222	218	227	209	218	211
13;02	237	229	234	215	216	215	223	209	211	218
13;12	222	222	215	215	223	222	209	218	218	218
13;22	218	222	215	218	218	218	215	218	218	215
13;32	222	223	211	222	215	218	208	211	208	222
13;42	215	215	218	215	215	229	223	227	218	215
13;52	211	218	216	218	218	218	218	218	218	216
14;02	222									

AVERAGE CONC = 218.4 PPM AS C1 FOR 91 MINUTES

19;37	295	286	291	303	300	295	275	282	308	286
19;47	282	282	279	288	289	315	342	336	349	333
19;57	333	8.71	295	275	303	308	298	279	270	270
20;07	267	274	274	265						

AVERAGE CONC = 286.2 PPM AS C1 FOR 34 MINUTES

CATALYTIC INCINERATOR PROGRAM PLANT NO 6 ATTN=500 MULT=4.444
THC CONCENTRATIONS AS C1 IN OUTLET STARTING AT 03/02 20;51

20;51	366	315	322	315	303	319	8.71	288	298	303
21;01	263	270	286	261	261	279	279	274	260	256
21;11	279	279	282	267	261	263	274	282	286	295
21;21	310									

AVERAGE CONC = 277.5 PPM AS C1 FOR 31 MINUTES

CATALYTIC INCINERATOR PROGRAM PLANT NO 6 ATTN=500 MULT=4.444
THC CONCENTRATIONS AS C1 IN OUTLET STARTING AT 03/03 09;32

09;32	230	228	227	223	218	230	209	218	237	232
09;42	239	247	246	247	254	254	251	256	254	265
09;52	270	265	263	253	253	253	261	256	263	270
10;02	270	274	270	263	267	263	267	263	270	267
10;12	261	270	261	267	267	270	279	282	282	272
10;22	274	274	279	270	279	279	279	274	279	279
10;32	288	282	277	272	274	279	274	270	270	267
10;42	282	279	279	282	279	286	291	291	300	288
10;52	295	295	295	300	303	295	307	303	301	300
11;02	288	298	291							

AVERAGE CONC = 268.7 PPM AS C1 FOR 93 MINUTES

11;44	260	237	279	295	279	263	253	237	253	254
11;54	272	270	265	270	275	282	267	270	279	282
12;04	279	267	279	286	288	279	270	279	282	288
12;14	286	282								

AVERAGE CONC = 271.9 PPM AS C1 FOR 32 MINUTES

15;56	193	202	232	242	216	235	240	246	235	242
16;06	240	244	230	237	247	246	239	237	240	249
16;16	240	244	247	251	244	244	254	239	244	247
16;26	256	260	253	253	249	246	247	249	247	249
16;36	253	253	247	253	260	267	251	256	254	260
16;46	254	246	251	261	249	254	254	256	261	256
16;56	260	254	254	261	253	253	256	254	265	249
17;06	249	253	256	256	256	265				

AVERAGE CONC = 248.0 PPM AS C1 FOR 76 MINUTES

CATALYTIC INCINERATOR PROGRAM PLANT NO 6 ATTN=500 MULT=4.432
THC CONCENTRATIONS AS C1 IN OUTLET STARTING AT 03/03 20;15

20;15	216	229	229	245	231	236	243	259	254	254
20;25	271	269	266	266	262	259	259	250	254	252
20;35	245	252	243	243	245	236	235	222	217	228
20;45	238	238	231	238	243	228	233	231	238	254

AVERAGE CONC = 243.5 PPM AS C1 FOR 40 MINUTES

21;02	238	236	255	238	275	266	259	250	255	254
21;12	259	252	250	247	243	249	250	252	245	245
21;22	250	250	252	252	245	249	245	243	247	245
21;32	255	247	249	243	247	245	252	252	252	249
21;42	250	249	249	245	243	250	252	245	255	245
21;52	247	245	252	243	250	252	249	247	252	247
22;02	250	247	245	249	250	250	245	250	249	247
22;12	245	240	250	247	250	247	252			

AVERAGE CONC = 248.9 PPM AS C1 FOR 77 MINUTES

23;43	240	236	240	243	243	236	249	235	238	235
23;53	229	245	240	252	235	243	238	231	235	236
00;03	236	236	243	235	235	236	236	233		

AVERAGE CONC = 238.1 PPM AS C1 FOR 28 MINUTES

CATALYTIC INCINERATOR PROGRAM PLANT NO 6 ATTN=500 MULT=4.432
THC CONCENTRATIONS AS C1 IN OUTLET STARTING AT 03/04 00;51

00;51	318	335	323	318	308	294	299	302	290	294
01;01	290	289	289	297	302	302	302	302	299	299
01;11	297	297	299	302	297	297	294	299	297	297
01;21	297	294	289	294	294	294	294	302	290	297
01;31	294	294	299	299	299	294	302	299	299	294
01;41	294	294	294	299	294	306	302	297	294	294
01;51	297	302	297	302	294	294	290			

AVERAGE CONC = 298.3 PPM AS C1 FOR 67 MINUTES

CATALYTIC INCINERATOR PROGRAM PLANT NO 6 ATTN=500 MULT=4.432
THC CONCENTRATIONS AS C1 IN OUTLET STARTING AT 03/04 02;43

02;43	280	299	332	334	339	335	334	327	330	318
02;53	309	311	299	294	290	299	294	287	287	287
03;03	302	302	302	290	297	302	302	302	294	302
03;13	302	302	308	302	297	294	297	297	295	302
03;23	297	302	302	297	297	302	297	302	302	290
03;33	302	297	308	297	294	302	287	294	302	294
03;43	297	302	308	297	294	294	290	315	299	299
03;53	294	290	294	297	290	294	297	294	297	297
04;03	299	297	294	299	294	299	294	290	294	290
04;13	290	302	302	294	302	297	302	299	299	299
04;23	297	299	297	297	294	302	306	297	297	290
04;33	290	299	302	294	299	294	294	290	289	294
04;43	294	299	299	294	290	294	294	290	294	297
04;53	294	290	287	297	306	294	297	294	289	299
05;03	294	290	294	294						

AVERAGE CONC = 298.6 PPM AS C1 FOR 144 MINUTES

05;40	309	322	306	306	302	306	309	302	302	302
05;50	294	290	290	290	287	302	294	297	294	294
06;00	294	289	299	294	294	302	290	302	302	299
06;10	299	294	297	294	290	299	299	302	294	290
06;20	294	294	294	302	294	302	302	290	302	302
06;30	297	302	295	297	302	302	297	294	289	294
06;40	299	302	297	299	297	294	289	302	294	294
06;50	302	302	294	294	289	294	294	299	297	302
07;00	299	290	297	302	294	294	302	290	289	294
07;10	289	294	294	299	289	287	294	299	294	294
07;20	289	289	287	299	287	285	290	285	289	294
07;30	294	294	290	294	299	294	287	294	297	294
07;40	299	297	289	297	290	294	285	289	297	287
07;50	289	289	289	289	282	297				

AVERAGE CONC = 295.3 PPM AS C1 FOR 136 MINUTES

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CATALYTIC INCINERATOR PROGRAM PLANT NO 6 ATTN=500 MULT=4.432
THC CONCENTRATIONS AS C1 IN OUTLET STARTING AT 03/04 17;31

17;31	261	294	299	308	315	289	290	278	282	273
17;41	278	278	278	282	285	287	282	275	290	285
17;51	285	294	294	294	285	287	289	290	285	278
18;01	285	278	266	278	269	278	278	273	278	269
18;11	282	269	273	276	269	282	273	273	282	273
18;21	285	275	278	278	269	287	278	278	283	278
18;31	290	275	278	276	273	278	266	275	269	269
18;41	282	273	278	282	278	287	273	278	269	269
18;51	282	269	285	273	275	275	275	278	269	276
19;01	271	269	287	273	275					

AVERAGE CONC = 279.1 PPM AS C1 FOR 95 MINUTES

21;27	243	238	249	252	240	229	240	226	245	255
21;37	221	217	262	255	262	255	252	255	259	261
21;47	259	254	245	243	243	250	249	255	252	252
21;57	261	252	261	252	254	266	250	262	255	255
22;07	261	254	259							

AVERAGE CONC = 250.2 PPM AS C1 FOR 43 MINUTES

APPENDIX B

RESULTS OF METHOD 2, 3, and 4 ANALYSES

The results of Method 2 and Method 4 measurements at Plant C-6 are summarized in Tables B-1 through B-5. Tables B-1 through B-4 contain results of volumetric flowrate measurements for the roof exhaust stack, combustion air inlet, main incinerator inlet, and the floor sweep. Results of moisture content measurements for the roof exhaust stack are given in Table B-5. Results shown in the tables were measured according to EPA Methods 1, 2, and 4.

The molecular weight used in the volumetric flowrate calculations was based on Fyrite and Byron 401 analyzer measurements. Oxygen and CO_2 data obtained were as follows:

Oxygen: 21% (from Fyrite measurements)

CO_2: range: 1.7 - 1.9% (from Byron 401 analyzer results)
average: 1.8%

Based on these data, the average wet molecular weight of incinerator gas was 28.7.

TABLE B-1. EPA METHOD 2 RESULTS FOR ROOF STACK, PLANT C-6

Run #	Date	Start Time	Volumetric Gas Flowrate dNm^3/sec	(dscfm)	Average Stack Gas Temperature °C	(°F)
1	2/25/83	18:00	a	(a)	a	(a)
4	2/28/83	14:37	2.06	(4363)	363	(685)
8	2/28/83	18:52	2.09	(4426)	363	(686)
13	3/2/83	13:23	2.42	(5139)	389	(733)
14	3/3/83	16:03	2.35	(4985)	307	(585)
17	3/3/83	21:25	2.44	(5180)	368	(695)
18	3/4/83	17:35	2.90	(6138)	349	(661)

[a]Process went down during sampling. No data are available.

TABLE B-2. EPA METHOD 2 RESULTS FOR COMBUSTION AIR, PLANT C-6

Run #	Date	Start Time	Volumetric Gas Flowrate dNm^3/sec	(dscfm)	Average Gas Temperature °C	(°F)
20	3/3/83	11:05	0.13	(285)	27	(80)

TABLE B-3. EPA METHOD 2 RESULTS FOR MAIN INLET, PLANT C-6

Run #	Date	Start Time	Volumetric Gas Flowrate dNm^3/sec	(dscfm)	Average Gas Temperature °C	(°F)
2	2/25/83	17:25	3.58	(7587)	154	(309)
5	2/28/83	15:50	4.51	(9570)	175	(347)
7	2/28/83	18:36	4.49	(9514)	174	(346)
10	3/1/83	18:40	4.52	(9580)	176	(348)
12	3/2/83	10:22	4.44	(9409)	171	(339)
16	3/3/83	17:10	4.46	(9447)	139	(282)
19	3/3/83	22:10	4.61	(9778)	157	(314)
23	3/4/83	18:32	4.51	(9561)	118	(244)

TABLE B-4. EPA METHOD 2 RESULTS FOR FLOOR SWEEP, PLANT C-6

Run #	Date	Start Time	Volumetric Gas Flowrate dNm^3/sec	(dscfm)	Average Gas Temperature °C	(°F)
3	2/25/83	18:09	a	(a)	a	(a)
6	2/28/83	16:02	0.46	(984)	27	(80)
9	2/28/83	19:20	0.43	(910)	29	(84)
11	3/1/83	18:40	0.48	(1015)	23	(74)
15	3/3/83	16:55	0.45	(954)	29	(84)
21	3/3/83	21:36	0.43	(916)	26	(79)
22	3/4/83	18:05	0.39	(818)	28	(83)

[a]Process down during sampling. No data are available.

TABLE B-5. RESULTS OF MOISTURE CONTENT MEASUREMENTS AT PLANT C-6

Run #	Date	Start Time	Stack Gas Moisture Content (%)
1	3/2/83	1004	4.34
2	3/3/83	2158	3.85
3	3/14/83	1800	_[a]

[a]Electrical short in heated sampling probe, run not completed.

APPENDIX C

RESULTS OF METHOD 18 ANALYSES

The results of Method 18 analyses for the incinerator inlet and outlet gas streams at Plant C-6 are presented in Tables C-1 and C-2.

TABLE C-1. RESULTS OF GAS CHROMATOGRAPHIC ANALYSES FROM PLANT C-6 - INLET
(Concentration are ppmvC quantitated against propane)

Date	Time	C_1	C_2 & C_3	C_4	MEK / C_5	C_6	Toluene / C_7+	THC	Product
2-25-83	0957		ND	ND	6640	ND	ND	6640	A
2-28-83	0739	30.0	ND	ND	3540	ND	3940	7510	B
	1412	14.7	ND	ND	3360	ND	4030	7410	B
	1446	14.4	ND	ND	3510	ND	4110	7640	B
	1556	15.0	ND	ND	3170	ND	3890	7070	B
	1648	15.0	ND	ND	3260	ND	3880	7120	B
	1941	15.0	ND	ND	3360	ND	4110	7480	B
3-1-83	1029	23.6	ND	5.2	3180	ND	3740	6950	B
	1427	14.1	ND	ND	2770	ND	5030	7810	B
3-2-83	0955	ND	ND	ND	3840	ND	4550	8390	B
	1019	ND	ND	ND	3910	ND	4650	8560	B
	1043	ND	ND	ND	3730	ND	4610	8340	B
3-3-83	1155	13.4	ND	210	1660	36	1980	3900	D
	1646	15.6	ND	217	1760	106	1940	4030	D
	1711	16.9	ND	268	1600	83.0	2030	3990	D
	2040	10.0	ND	ND	2830	ND	3410	6240	B
	2110	21.0	ND	ND	2850	ND	3290	6160	B
	2132	14.2	ND	ND	2790	ND	3390	6190	B
3-4-83	1527	15.2	ND	ND	1320	ND	6080	7420	E
	1734	15.0	ND	ND	1690	ND	5600	7310	E
	1752	14.7	ND	ND	1960	ND	5240	7210	E
	1823	14.0	ND	ND	2120	ND	4980	7120	E
				FLOOR SWEEP INLET					
2-28-83	1728	ND	ND	ND	1370	ND	629	2000	B
	1836	ND	ND	ND	1260	ND	553	1810	B
3-3-83	2329	ND	ND	ND	1180	ND	553	1710	B
3-4-83	1947	17.8	ND	ND	836	ND	715	1570	E

ND = Not Detected. Detection limit = 9.0 ppmvC.

TABLE C-2. RESULTS OF GAS CHROMATOGRAPHIC ANALYSES FROM PLANT C-6 - OUTLET
(Concentrations are ppmvC quantitated agains propane)

Date	Time	C_1	C_2&C_3	C_4	C_5	C_6	C_7+	THC	Product
3/1/83	1722	14.8	ND	ND	91.5	ND	180	286	A
	1752	14.4	ND	ND	92.5	ND	178	285	A
	1820	27.1	ND	ND	69.4	ND	176	272	A
	1842	22.2	ND	ND	58.8	ND	171	252	A
	2013	13.8	ND	ND	70.9	ND	173	258	A
	2033	13.8	ND	ND	71	ND	165	250	A
3/2/83	1248	13.3	ND	ND	86.0	ND	95.2	195	B
	1310	12.8	ND	ND	85.5	ND	93.5	192	B
	1334	15.3	ND	ND	~87	ND	104	206	B
	1356	14.3	ND	ND	~87	ND	97.7	199	B
3/3/83	1602	17.9	ND	17.1	114	ND	63.5	213	D
	1626	13.8	ND	9.1	112	ND	67.8	203	D
	2232	13.9	ND	ND	58.3	ND	97.8	170	B
	2305	13.2	ND	ND	58.2	ND	97.9	169	B
	2356	15.3	ND	ND	114	ND	113	242	B
3/4/83	1843	22.3	ND	ND	57.7	ND	163	243	E
	1908	14.8	ND	ND	84.1	ND	155	254	E
	1928	15.0	ND	ND	80.5	ND	164	260	E
	2007	15.7	ND	ND	94.9	ND	160	271	E

ND = Not detected. Detection Limit = 9.0 ppmvC.

APPENDIX D

GAS CHROMATOGRAPHY/MASS SPECTROMETRY (GC/MS) RESULTS

Appendix D contains the results of GC/MS analyses of incinerator inlet and catalyst outlet gas samples. These samples were collected during coating operations using Products B, D, and E. Table D-1 summarizes the major compounds identified in the gas samples, the level of confidence at which they were identified and corresponding concentrations.

The GC/MS data is used primarily as a source of qualitative information. The compounds listed in the table all have identification confidence levels associated with them. These confidence levels are defined as follows:

Level 1 - Compound is definitely present. Retention time and mass spectra match known standards.

Level 2 - Compound is probably present. No retention time standard is available but mass spectra match well with library spectra.

Level 3 - This compound represents the best guess for the data available. This could be identified as another compound with the same molecular weight.

The concentrations reported are calculated against a toluene response factor, and are reported as toluene. These concentrations should be viewed only on a semi-quantitative basis. Concentration data would be most useful for comparing the relative amounts of one compound to another within the same sample.

Data from Table D-1 show the absence of MEK in the inlet samples. Since MEK is known to be present in the inlet gas, it is believed that the MEK was dissolved in the water of the impingers upstream of the sampling point.

TABLE D-1. RESULTS OF GC/MS ANALYSES OF GAS SAMPLES COLLECTED AT PLANT C-6 (Concentrations are given in ppmv quantitated against toluene)

Compound	Identification Confidence Level	Concentration (ppmv)			
		Product B Inlet	Product B Outlet	Product D Inlet[a]	Product E Inlet
Dimethyl ether[b]	3	21	4.0	34	
Acetone	2		1.6		
Methyl ethyl ketone	2		5.4		
Freon 113[b]	2	1.8	0.15	2.4	
Pyridine[b]	2	0.10			
n-Hexane	1		0.69		4.6
Methylcyclopentane	2		0.23		
Methyl isobutyl ketone	2		0.09		
Toluene	1	0.60	0.19	2.8	87

[a]Values represent the average concentration from 2 analyses of the same sample.

[b]Compound is most likely a laboratory contaminant.

APPENDIX E
EXAMPLE CALCULATIONS

Methods used to calculate destruction efficiency and heat recovery are presented in the following subsections.

E.1 DESTRUCTION EFFICIENCY

For Plant C-6, the destruction efficiency is based on inlet and outlet THC mass rates as follows:

$$DE = \frac{Min - Mout}{Min} \times 100\%$$

where DE = destruction efficiency, %

Min = inlet THC mass rate, g C/sec

Mout = outlet THC mass rate, g C/sec

The inlet THC mass rate, Min, was calculated as the sum of three mass rates:

$$Min = Mmi + Mfs + Mca$$

where Mmi = main inlet THC mass rate, g C/sec

Mfs = floor sweep THC mass rate, g C/sec

Mca = combustion air THC mass rate, g C/sec

THC mass rates are based on measured Method 25A concentrations and gas flowrates:

$$M = \frac{(V)\ \text{moles C}}{10^6\ \text{moles gas}} \times \frac{12\text{gC}}{\text{mole C}} \times \frac{\text{mole gas}}{0.024\ \text{m}^3\ \text{gas}} \times \frac{(Q)\ \text{m}^3\ \text{gas}}{\text{sec}}$$

where M = THC mass rate, g C/sec

V = THC concentration, ppmv (main inlet, floor sweep, combustion air or outlet)

Q = gas flowrate, Nm^3/sec (main inlet, floor sweep, combustion air or outlet)

Standard or normal conditions refer to one atmosphere of pressure and 20°C (68°F).

E.2 HEAT RECOVERY

For Plant C-6, heat recovery was defined as the percent of heat generated by natural gas and solvent combustion that is reused in the process. The heat reused in the process was assumed to be equivalent to all heat not exiting the process with the stack exhaust gas. Heat recovery was then calculated as follows:

$$HR = \left[1 - \frac{Q_{ex}}{Q_{gen}}\right] \times 100\%$$

where HR = heat recovery, %

Q_{ex} = heat added to stack exhaust gas by natural gas and solvent combustion, J/sec

Q_{gen} = total heat generated by natural gas and solvent combustion, J/sec

The above equation is solved by making the following assumptions and substitutions:

$$HR = \left[1 - \frac{m_{stack}\ Cp(T_{stack} - T_{sys\ in})}{m_{SLA}\ Cp(T_{catout} - T_{SLA\ in})}\right] \times 100\%$$

where m = gas mass flowrate (stack gas or SLA), g mole/sec

Cp = average specific heat of SLA for the range of temperature, J/g mole °K

T_{stack} = temperature of the stack exhaust gas, °K

$T_{sys\ in}$ = temperature of system in leakage air entering the ends of the drying oven, °K

T_{catout} = temperature of SLA exiting the catalyst bed, °K

$T_{SLA\ in}$ = temperature of SLA entering the incinerator, °K

The temperature of the in leakage air is equal to the ambient temperature of the coating room near the oven or approximately 32°C (90°F).